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Water Footprint: Useful for sustainability policies?

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Local context essential for making water footprint approach useful for sustainability policies

Water scarcity and pollution are growing problems that constitute a risk for economic development and food security in several world regions. These local problems have a global dimension because supply chains and trade link the ‘virtual water’ that is embedded in products to consumption in other parts of the world. The water footprint approach addresses this global dimension of water scarcity and pollution, as it assigns these ‘virtual’ freshwater volumes to products, consumers, producers and countries. The water footprint indicator has been effectively used as a wake-up call to raise awareness among the general public, businesses and governments about the global scale of water appropriation. Even so, as these water volumes hardly reflect environmental impact, the water footprint indicator is unsuitable to be used for goal-setting, policy-making, monitoring and evaluation, in relation to sustainability.

However, when water footprint components are placed in their physical and socioeconomic context, unsustainable ‘hot spots’ can be traced. For example, when a production process uses water from overexploited water resources, pollutes water to the point of exceeding water quality standards, or when water allocation and use are considered unfair or inefficient. This approach fits with the growing attention paid to supply chains from a general sustainability or business-risk perspective, and may contribute to the mitigation of global water problems. It may generate additional resolving power, as – in addition to local stakeholders and authorities – it also involves distant consumers, producers and investors along the supply chain when addressing water problems in unsustainable hot-spot areas. In this way, the strategies for integrated water resource management (IWRM) in catchment areas and those of risk reduction by companies may reinforce each other.

Main findings

Introduction

On 12 April 2012, the Dutch House of Representatives approved a resolution about the large amount of 'virtual' water imported into the Netherlands. The resolution proposed that the Dutch Government, in its economic policy, will advocate that Dutch enterprises reveal their water footprint as well as reduce this footprint in countries with water scarcity. Following this resolution, the Minister of Foreign Affairs asked the PBL Netherlands Environmental Assessment Agency to investigate the extent to which the water footprint would be a suitable instrument for Dutch policy-making. In a further explanation, the Ministry of Foreign Affairs also asked for an overview of the state-of-the-art in water footprint approaches and their application by different actors, especially businesses and NGOs. The ministry indicated to be interested in any relationship between these initiatives and how these could contribute to stimulate sustainable water use.

Water resources are being used unsustainably in large regions of the world

The overexploitation of water resources and water pollution is a growing problem that constitutes a risk for economic development and food security in several world regions. The number of people living in severely water-stressed river basins is projected to increase from 1.6 billion in 2000 to 3.9 billion by 2050, or over 40% of the world population of 2050. The majority live in densely populated areas in countries with rapidly developing economies. Furthermore, at least 20% of the world's groundwater aquifers are considered to be overexploited. The quality of surface waters and groundwater is expected to deteriorate in the coming decades, due to micro-pollutants, pesticides and nutrient overloading. These problems have a global dimension because the 'virtual water' embedded in products links them to consumption in other parts of the world through international supply chains and trade.

Water footprint indicator has created awareness of water use in international supply chains

The water footprint indicator, which assigns virtual water volumes to products, consumers, producers and countries, has been effectively applied as a communication instrument to make the general public, businesses and governments aware of the large volumes of water used in international supply chains for the production of goods. As a result, public and private parties have been stimulated into joining networks and partnerships, performing water footprint pilot studies and starting projects to reduce water use and pollution in production processes along supply chains. Also new methods and databases have been developed that are useful for water assessments. NGOs have played an important role in this process in communication, initiating networks, partnerships and pilot studies, and developing standards.

However, even though the volumes of water that are needed to produce goods are impressive, they do not tell us much about the sustainability of this water use. For instance, growing a crop with a large water footprint in a water-abundant environment can be sustainable, whereas growing a crop with a small water footprint in a dry area with overexploited water resources would be unsustainable. Therefore, the water footprint indicator is not suitable to be used for setting targets and developing strategies for sustainability policies, nor to use for benchmarking, certifying or monitoring company, consumer or country progress towards sustainable water use. Moreover, the indicator does not offer correct information for consumers to make a sustainable choice. Along the same lines, the large amounts of 'virtual' water imported into the Netherlands do not necessarily reflect large environmental impact.

Local context of water footprint components essential to sustainability policies

In order for the water footprint approach to be useful for sustainability policies, first of all one should differentiate between the three water types: ‘green water’ (evaporated rainwater used for growing crops), ‘blue water’ (surface water and groundwater used for irrigation, and industrial and domestic use) and ‘grey water’ (polluted water), as they all have different environmental effects. Most of the time, the green water footprint is by far the largest with regard to water volume, but environmental problems are related to the blue and grey water footprints. The water footprint indicators per water type should be placed in their physical and socioeconomic context to reveal their possible contribution to water-related problems. Therefore the locations of the water footprint components need to be known. Policies could focus on ‘unsustainable hot spots’, locations where a production process uses water from overexploited water resources, pollutes water to the point of exceeding water quality standards, or where water allocation and use are considered unfair or inefficient. A water footprint sustainability assessment addresses all these aspects, but methods and applications are still developing and in an experimental phase. Nevertheless, frontrunner companies are already assessing water use and pollution along their supply chains to trace and track hot spots. Instead of revealing their overall water footprint indicator in their sustainability reports, companies would do better to report any progress made in reducing the separate components of their water footprint in those unsustainable hot spots.

The strength of this approach would be the involvement of distant consumers, producers, retailers and investors – in addition to local stakeholders and authorities – in addressing water problems in hot-spot areas. All actors involved share the interest and responsibility to manage water resources well. In this way, strategies of integrated water resource management in catchment or sub-catchment areas can be supplemented with companies’ strategies of risk perception and reduction, thus reinforcing each other. This fits well with the growing attention of companies and investors for sustainable corporate water management and water-related business risks, addressing both direct and supply chain operations. Tools and reporting formats have been developed to support these initiatives in the context of corporate risk assessment, standards for good water stewardship and Life Cycle Assessment. These initiatives could join forces with the water footprint community, to support further development and practical application of methods and tools supporting sustainable water use in product and supply chains. This is already happening in certain initiatives.

Prominent trade position of the Netherlands offers opportunities

The prominent position of the Netherlands in the global agricultural market offers opportunities to stimulate companies to trace their hot spots, work on reducing water stress and pollution in these hot spots, and prevent the emergence of new ones. The Dutch Government may build on the increasing public awareness of the global dimension of water problems to urge companies to act accordingly. Government, companies, NGOs and networks, such as sector organisations and round-tables, could collaborate in this process. Policy should start from a clear view of the relationship of Dutch consumption and production with the global hot spots of water scarcity and pollution and the actors involved. However, data gathering and processing on a national scale are not accurate enough to allow for this. Top-down generated data based on trade statistics are insufficiently geographically focused, and currently there is no institution that - bottom-up - gathers and subsequently aggregates data generated by companies into information about hot spots on a national scale. For the time being, an update of top-down generated data to determine potentially risky commodities could be combined with assessments carried out by companies to verify these findings.

The Dutch Government requires from internationally operating companies that they comply with the OECD Guidelines for multinational enterprises. These recently have been supplemented with new guidelines that deal with supply chains in addition to production processes by companies themselves, but do not specifically address water issues. Tracing hot spots in production and supply chains and working on solutions with local authorities and stakeholders in the context of integrated water resource management could be considered to be an interpretation of addressing water issues according to the general guideline ‘dealing responsibly with natural resources’.

Several angles for Dutch policies to stimulate sustainable water use

Sustainable water use may be addressed in several policy fields and focused on consumer behaviour, resource efficiency in the product and supply chains, reducing impacts in catchment or sub-catchment areas, and reducing the use of hazardous materials in general. In addition to the actions mentioned above, the Dutch Government may also, for example:

- support campaigns educating consumers to raise awareness of environmental impacts of consumption including impacts on global water resources;
- stimulate Dutch enterprises that do business abroad, to meet sustainability standards that include sustainable water management in the product and supply chains;
- stimulate innovations that serve good water management in relevant top sectors;
- encourage partner countries in international cooperation that face water scarcity or pollution problems to carry out economic risk assessments regarding their water use and allocation;
- open up dialogues with international funding organisations and other relevant parties on tensions between export activities and water scarcity and pollution;
- apply a ‘water risks and sustainability’ check, within the framework of international cooperation, for supported economic projects in partner countries;
- stimulate cooperation between different networks to join forces for the development of tools and databases that are useful to make product and supply chains sustainable, also regarding water;
- stimulate initiatives to internationally harmonise standards for good water stewardship and corporate water disclosure;
- support initiatives to internationally harmonise the way water issues are addressed in product labelling.

Full results

1 Introduction

On 12 April 2012, the Dutch House of Representatives approved a resolution submitted by its members Hachchi and Ferrier about the large amount of 'virtual' water imported into the Netherlands, proposing that the Dutch Government, in its economic policy, advocates that Dutch enterprises reveal their water footprint and reduce it in countries with water scarcity. This could be done, for example, by addressing those companies that receive support via export guarantees or innovation subsidies, asking that they reduce their water footprint as well as include the water footprint indicator in their sustainability reports (Appendix 1). Following this resolution, the Dutch Minister of Foreign Affairs asked the PBL Netherlands Environmental Assessment Agency to investigate the extent to which the water footprint would be a suitable instrument for Dutch policy-making (Appendix 2). Policy-making, here, is interpreted in a broad sense, as, in the same letter, the minister mentioned that the research question concerns policy coherence in order to address the problem of water scarcity. In addition, staff members of the Ministry of Foreign Affairs asked for an overview of the state of the art in water footprint approaches and their applications by different actors, especially businesses and NGOs. They indicated to be interested in how these initiatives are related and what angles could be found to use them to stimulate sustainable water use.

In this PBL Note, policy-making refers to policies aimed at achieving sustainable use of water, worldwide. The water footprint is interpreted as a concept that addresses the global dimension of water scarcity and pollution by assessing the use of fresh water and the emission of pollutants to water in all the processes around the production and use of a product, including those of the supply chain. The water footprint concept has been worked out into several instruments, one of them being the widely publicised and well-known water footprint indicator that assigns water volumes to products, producers, consumers and nations. As the water footprint theory has been evolving, more instruments have been developed.

Footprint approaches are part of the Dutch Sustainability Agenda (Ministry of IenM, 2011) and 'sustainable supply chains' is one of the focal points of this agenda. The Dutch Taskforce on Biodiversity and Natural Resources advised to halve the ecological footprint of Dutch consumption by 2030 and fit the footprint to the earth's bio capacity by 2050 (TBNH, 2011). Although water is recognised as an important natural resource, the Sustainability Agenda, the Sustainability Monitor for the Netherlands (CBS, 2011) as well as the taskforce only mentioned the ecological footprint that reflects land use and greenhouse gas emissions, and not the water footprint.

Dutch economic policies focus on a number of top sectors. Water is an important production factor in the two top sectors of agri-food and horticulture. Water is also related to the top sectors on chemistry and of course water. Water, food security and sustainable trade are focal points of policy on Dutch International Cooperation.

The PBL Netherlands Environmental Assessment Agency published a study in August 2012 about ecological footprints of the Netherlands and the usefulness of footprint approaches for Dutch policy-making (Van Oorschot et al., 2012). This publication briefly addresses also the water footprint. The present note focuses on the water footprint and its potential for coherent Dutch policy-making to stimulate sustainable water use. Chapter 2 describes the water footprint concept and includes certain criticisms of the concept. Chapter 3 sketches the water footprint of the Netherlands, and Chapter 4 describes the strategies for reducing the environmental impacts related to this water footprint. Many actors are involved with water footprints and water footprint approaches; Chapter 5 presents a selection of these actors, including their roles and interconnections. Chapter 6 discusses the usefulness of the water footprint indicator for certification and labelling. Chapter 7 discusses the usefulness of the water footprint for policy-making, in general, and answers the central question of the extent to which the water footprint would be a suitable instrument for Dutch policy-making, in particular.

2 Water footprint concepts

2.1 Introduction

The water footprint concept was introduced by Hoekstra in 2002 (Hoekstra and Hung, 2002; Hoekstra, 2003) and has been gaining popularity, worldwide. A current Internet search using Google results in around 780,000 hits for ‘water footprint’. Information about the water footprint is also widely available from Dutch websites of municipalities, water boards, businesses, networks, NGOs and other organisations, informing the public of the large water use that is indirectly being caused by the consumption of goods. The Dutch word for water footprint (‘watervoetafdruk’ or ‘water voetafdruk’) results in around 11,000 google hits.

According to the Water Footprint Assessment Manual of the Water Footprint Network (WFN) (Hoekstra et al., 2011), the goal of assessing water footprints is to analyse how human consumption relates to the issues of water scarcity and pollution, and to see how consumption can become more sustainable from a water perspective. Human consumption is linked to freshwater use and the emission of pollutants to water along production and supply chains of consumer products and their use. The tool to analyse water footprints is what is called a ‘water footprint assessment’. In the accounting phase of such an assessment, the aggregated water footprint indicator is calculated by assigning water volumes to products, producers and consumers.

This chapter gives an overview of the water footprint assessment methodology of the Water Footprint Network (WFN). It also describes the criticisms of the concept and indicator along with an alternative approach to water footprints in the context of Life Cycle Assessments (LCAs). In addition to the water footprint developed by the WFN, a separate groundwater footprint was developed, assessing water stress in groundwater aquifers.

2.2 The water footprint

The water footprint indicator refers to all water use and emissions to water, including leaching and run-off, associated with the processes to make a product or deliver a service. This includes both direct water use and emissions to water by the manufacturer and indirect water use and emissions to water along the supply chain of all ingredients including packaging. When viewed from a consumer perspective, the water footprint indicator for a product also includes the water use and emissions to water associated with its use.

Water use is measured in terms of water volumes consumed, evaporated or incorporated into the product. Green water refers to rainwater used for growing crops, blue water to surface water and groundwater used for irrigation and industrial and domestic use. Grey water is a measure for the severity of emissions of pollutants to water. Grey water is calculated as the volume of fresh water that would be required to assimilate the load of pollutants delivered to a freshwater resource given the natural background concentrations and existing water quality standards, whether or not this freshwater volume is actually available.

Water footprint indicators are also defined for other things than products; for instance, for producers, sectors, consumers or nations. These water footprint indicators consist of the sum of the water footprint indicators for all products produced or consumed by them. In the case of nations a distinction is often made between the domestic or internal part of the water footprint and the foreign or external part, the latter is also referred to as 'virtual' water import.

2.3 Development in water footprint methodology

During the first years of the development of the water footprint concept (2002–2008), the focus was on calculating the footprint's total size. This resulted, for instance, in the notion that one apple costs 125 litres of water and one cotton shirt about 2500 litres (WFN, 2012). These large volumes of water connected to products captured the imagination of many, and NGOs have used them to raise awareness among consumers, producers and governments about the size and global dimensions of water use related to consumer products. The location of the footprint components and their geographic context received little attention. From 2008 onwards, more attention has been given to the location of footprints and their geographic context. The water footprint theory has evolved from an accounting method for calculating an indicator to a methodology to perform water footprint assessments in which the accounting phase is followed by an impact or sustainability assessment. An early example of such an assessment is the study by Van Oel et al. (2008) that relates the water footprint indicators for Dutch consumption to locations with water scarcity. This development has also directed the research by the WFN towards the mapping of global water scarcity and pollution (Hoekstra et al., 2012; Liu et al., 2012).

It should be noted that the developments around the water footprint concept have resulted in some confusion about the footprint's exact meaning. Originally, the water footprint was synonymous with its total volume, resulting in the well-known water volumes assigned to products. However, currently, and in the context of a water footprint sustainability assessment, it is considered a geographically explicit indicator, representing not only water-use volumes and pollution, but also showing the locations of the footprint. This is logical, as a water footprint sustainability assessment focuses on the water footprint components in different catchments and sub-catchments, and not on the total size of the water footprint. Confusion about the definition of the water footprint also has been created by various WFN publications and in particular by the WFN manual, which uses both definitions side by side.

In this note we will use the term 'water footprint indicator' when the total volume of the water footprint is meant, which is calculated according to the water accounting phase described in the WFN manual.

2.4 Water footprint assessment

A full water footprint assessment as described in the WFN manual consists of four phases: 1) setting goals and scope; 2) water footprint accounting; 3) water footprint sustainability assessment; and 4) response formulation. Depending on the goal of the study, a water footprint assessment may also consist of just the first two or three phases. Studies on virtual water trade and studies carried out to estimate the water footprint indicator for products typically only consist of the first two phases. When the focus is on the impacts related to the water footprint, the assessment will comprise the first three or all four phases.

Water footprint accounting
The main goal of the accounting phase is to inventory green, blue and grey water volumes associated with the processes around the making and use of the products considered, including their ingredients. These data are used to calculate the aggregated water footprint indicator by adding up all water volumes of the inventory. They can also be used to calculate water footprint components such as the green, blue and grey water footprint components, or the imported 'virtual' water from various countries as components of the water footprint indicator for national consumption. When calculated for a particular product while ignoring product use, the water footprint indicator is also referred to as the 'virtual' water content of the product. Depending on the type of study, the water footprint accounting phase could also be the basis for a sustainability assessment.

Water footprint sustainability assessment
The main goal of a water footprint sustainability assessment is to trace processes along the production and supply chains or those associated with product use, which are located in unsustainable 'hot spot' areas. A hot spot is a location where a production process uses water from overexploited water resources, pollutes water above water quality standards or where water allocation and use are considered unfair or economically inefficient. To trace hot spots, the major water footprint components are viewed in their geographic context, preferably at catchment or sub-catchment level. The catchment areas concerned are assessed on sustainable water use, taking into account all major claims on water resources and emissions to water within the catchment or sub-catchment. If the required data are not available, separate catchment studies should be done. A catchment's possible environmental unsustainability is determined by the degree of blue and green water scarcity and the water pollution level, taking into account temporal aspects, as problems of water scarcity and pollution may be concentrated around certain periods of the year. Social unsustainability is considered to tbe the case when basic human needs are not being met for all people in the catchment or sub-catchment area or when basic rules of fairness are not being applied for water-related issues. And economic unsustainability would refer to a situation where water is neither allocated nor used in an economically efficient way. The temporal aspect of water scarcity is becoming more important

as climate change may influence precipitation patterns as well as total amounts.
The sustainability assessment phase may also be used to identify processes which could be considered unsustainable in themselves – independent of the geographic context – such as processes for which direct water use and emissions to water could be reduced or avoided altogether against acceptable costs.

Theory, methods and tools of a full water footprint assessment as well as its practical application are still developing and in an experimental phase.

Response formulation

To support response formulation with respect to the detected hot spots and water-inefficient processes, the WFN manual gives an overview of response options for various actors, including consumers, companies, farmers, investors and governments. It pleads for both a global and local scope to find solutions. On a global scale, for instance, water-intensive production processes would best be located in water-abundant areas, and optimal use could be made of rain-fed agriculture to release the pressure on water-scarce areas. On a local scale, one could think of technical measures to reduce water use and pollution, and optimisation of water allocation according to fairness or economic criteria.

2. 5 Criticisms of the water footprint concept

Criticisms of the water footprint concept all concern its highly aggregated volumetric indicator (Pfister et al., 2009; Jewitt, 2009; Ridoutt and Pfister, 2010; TCCC, 2010; PepsiCo, 2010; Gawel and Bernsen, 2011; Postle et al., 2011; Hellegers, 2011; Jeswani and Azapagic, 2011; Vannevel, 2012; Chapagain and Tickner, 2012).

The most important criticism concerns the weak relationship between the footprint's indicator and the footprint's environmental impact. The water footprint indicator, or at least its blue and green components, measures resource use and not environmental impact as would be expected from a footprint indicator. A crop may have a large 'virtual' water content but little environmental impact, as it is growing in a water-abundant environment, whereas a crop with a lower 'virtual' water content may have a significant environmental impact by using scarce blue water supplies. To compare the environmental friendliness of products, it is of little value to compare their water footprint indicators. This especially applies to the green water component, usually the major component of a water footprint indicator. Evaporation of rainwater and transpiration from plants are natural processes of the hydrological cycle and evapotranspiration from natural vegetation may even exceed evapotranspiration from crops. Counting only the 'net' green water footprint, and correcting for the evapotranspiration from natural vegetation, seems to be more appropriate if environmental impacts are considered (SABMiller, 2009). The few environmental impacts of a green water footprint also means that taking green water into account in a water footprint assessment to detect hot spots is a questionable method. In this respect, the WFN manual states that the green water footprint in relation to sustainability needs further research and it recommends to exclude a quantitative assessment of green water scarcity from practical policy-making for the time being. Nevertheless, considering the green water content of water-intensive commodities can be useful in the context of resource use and international trade. In such a case, green water is looked at as a scarce resource and not as a source of environmental damage (Hoekstra and Mekonnen, 2012b). Moreover, the green water footprint can be relevant in the context of fair water allocation and efficient water use in catchment and sub-catchment areas.

For the grey water footprint indicator, it could be argued that the severity of the environmental impact is indicated by it, as it compares pollution to water quality standards. The conversion of polluting emissions to water into water volumes using water quality standards enables comparison between the environmental impacts of the different emissions, so that they can be added up to form an indicator for environmental impact in a meaningful way. Along these lines, Berger and Finkbeiner (2010) considered the grey water footprint indicator an impact indicator from a Life Cycle Analysis perspective (see Section 2.6).

Other aspects of the water footprint concept also have been criticised, such as the attempt to combine water quantity and quality aspects in one single indicator and the way water pollution is converted into volumes of grey water. Also the lack of reliable data to actually calculate water footprint indicators is a source of criticism. Water quality is less elaborated than water quantity in the water footprint concept and databases. The immense variety of pollutants, their use and behaviour make it a laborious task to include water quality aspects in water footprint assessments. Nevertheless, water quality is also a growing global problem, in addition to water quantity, with risks for the environment and human health (Schwarzenbach et al., 2010; OECD, 2012).

Finally, it is argued that the full water footprint assessment provides nothing that is not already provided by existing water resource management and supply chain assessment tools (Wichelns, 2010). The concept would be one of sticking new labels on old concepts. However, one may also argue that there is added value in bringing together existing tools for water resource management and supply chain management to form one complete approach, because it connects two different worlds of researchers and users, which may be fruitful for new insights.

2.6 Water footprints in Life Cycle Assessments

Life Cycle Assessment (LCA) is a methodology for assessing the environmental performance of a product or service over its life cycle from cradle to grave, and addresses basically all environmental impacts caused by the use of fossil fuels and other natural resources and of the emission of harmful substances to air, water and soil. Elementary materials and energy flows are quantified in a Life Cycle Inventory (LCI), while environmental impacts from resource use and emissions are quantified in a Live Cycle Impact Assessments (LCIA) for 'impact categories' such as ozone depletion, climate change, acidification and eutrophication, and higher level impact categories such as human health, ecosystem quality and resource depletion. In addition to these quantifications of overall environmental impact, an LCIA also allows for the detection of environmental hot spots in production and supply chains, as a basis for optimising the environmental performance of a particular product or service.

This all makes LCA a potential tool for assessing the environmental sustainability of products regarding water and thus a potential alternative to the WFN water footprint approach. However, traditionally only the grey water footprint is covered by LCA, through the assessment of the emission of harmful substances to water according to impact categories such as eutrophication and aquatic toxicity. Until recently, water use was largely neglected in LCAs. Methods for taking the impacts of blue water use into account are now being developed, while green water is hardly considered at all (Berger and Finkbeiner, 2010; Jeswani and Azapagic, 2011; Pfister, 2011; Jefferies et al., 2012).

Furthermore, LCAs traditionally take a rather generic approach to spatial differentiations using average conditions on a continent or in a country (ACLCA, 2012; IWP, 2012). Many types of damages, such as acidification or toxicological or eco-toxicological impacts on humans and ecosystems, often are regional or local impacts, making it important to evaluate them in their geographic context. In current LCA approaches, such non-global impacts are often calculated on a continent or country basis. This has restricted the confidence in these impact calculations presented in LCAs. Regionalisation is therefore recognised as an important step towards improving the accuracy and precision of LCA results. As also the assessment of water use requires regional distinction, the current research on the integration of blue water use in LCAs takes regionalisation into account. The impact of blue water use is often represented by a water withdrawal or consumption to availability ratio in a catchment area, so water from a water body that is over-exploited would have a higher weighting than water from one that is under-utilised.

In May 2012, a new operational LCA method was launched called the 'IMPACT World+'. This method addresses both water use and regionalisation (ILCC, 2012; IWP, 2012; Rosenbaum et al., 2012; Margni et al., 2012). The method assesses worldwide impacts of blue water consumption on a watershed level on aspects such as human health and aquatic and terrestrial ecosystem quality. Together with the calculation of regionalised impacts of emissions to water, using traditional LCA impact categories, the new method addresses blue water scarcity as well as water pollution in a spatially differentiated way.

The LCA approach to water footprints is also adopted in the development of the ISO standard 14046, which is to provide a specification of requirements and guidelines to assess and report on the water footprints of products, processes and organisations, based on LCAs (Humbert, 2010; Postle et al., 2011; ISO, 2012). Implementation of this standard has been planned for 2014 (Margni et al., 2012).

However, it is difficult to predict the extent to which recent developments of the integration of water footprint indicators in LCAs may lead to practicable tools that could, for instance, be used by companies to assess their water footprints and to detect the unsustainable hot spots along their production and supply chains.

2.7 Groundwater footprint

Gleeson et al. (2012) have launched the 'groundwater footprint' concept, which reveals the water balance of global aquifers. According to this concept, the water balance between groundwater aquifer inflows and outflows is converted to a surface area size which is called the 'groundwater footprint' and can be compared to the surface area of the groundwater aquifer. Groundwater stress occurs if the footprint area is larger than the area of the aquifer itself, and varies in severity depending on the ratio between the area of the footprint and the area of the aquifer. The footprint only addresses 'hydrologically active' aquifers that are replenished, and therefore does not include fossil groundwater. The groundwater footprint concept does not relate groundwater use to consumption of products via production and supply chains. Gleeson et al. (2012) conclude that at least 20% of the world's 'active' aquifers are overexploited – some of them heavily – and that currently 1.7 billion people live in areas with groundwater stress.

This new concept can complement the water footprint sustainability assessment that focuses on water balances of catchment areas. Groundwater aquifers have different geographical boundaries from those of catchment areas, although they are hydrologically related to these areas. Water stress in catchment areas may cause groundwater depletion. Therefore, there is a large geographical overlap between catchment areas with water stress and groundwater aquifers with water stress. The groundwater footprint approach is useful for water footprint assessments as it maps areas with groundwater scarcity in addition to catchment areas with water scarcity. This also implies that the source of the water used (surface water, shallow groundwater or deep groundwater) is relevant information to determine the scope of the environmental impact.

2.8 Conclusions

Water footprint useful for policy-making if its local context is assessed
The WFN water footprint indicator contains an inconsistent set of incomparable components. The blue and green water components are resource-use indicators that do not reflect the impacts of water use, while the grey water component is an environmental impact indicator. In addition, the blue and green water components represent incomparable types of water uses which cannot simply be added together; blue water use represents a direct human intervention in the hydrological cycle, while green water use represents water uptake by crops that may not differ significantly from the uptake by natural vegetation. This makes the water footprint indicator and data on virtual water trade difficult to interpret and not suitable to reflect environmental impact.

Therefore, the WFN aggregated water footprint indicator is not useful to set targets and develop strategies for Dutch sustainability policies, nor can it be used for benchmarking or certification, or for monitoring the progress of consumers or a particular country or company towards sustainable water use. It even may lead to wrong decisions if actors are misinformed.

Recent developments in water footprint theory towards a focus on the geographic context of the various water footprint components and the link with water scarcity and pollution, provide opportunities for sustainability policies. The water footprint assessment, including the sustainability assessment phase, is an instrument that could be used, for instance, by companies to trace unsustainable hot spots along their production and supply chains. Frontrunner companies are already acting this way (see Appendix 3). In hot-spot areas companies could contribute to the mitigation of water scarcity or pollution by collaborating with suppliers, local stakeholders and authorities. In this way, the new 'water footprint thinking' may complement strategies of integrated water resource management (IWRM) at catchment and sub-catchment levels. As the concept of full water footprint assessment is rather new, more testing is needed in practice to explore and improve its usefulness and practicality. Also water pollution has not been sufficiently elaborated, yet. Here, cooperation between water footprint and LCA method development could be helpful. Both methods, LCA and water footprint assessment, seem to converge on the issue of putting resource use and environmental impacts in their geographic contexts.

Developments in Life Cycle Assessments towards water use and regionalisation provide an alternative approach to water footprint assessments. However, currently, it is difficult to predict the extent to which these developments will lead to practicable tools that could be used, for example, by companies to manage their water footprints.

The groundwater footprint enhances the knowledge about water scarcity as it adds information on water stress in groundwater aquifers to that on water scarcity in catchment areas.

3 Water footprint of the Netherlands

3.1 Introduction

The motion by Hachchi and Ferrier mentions the large amount of ‘virtual’ water imported into the Netherlands as well as water use in relation to water scarcity. This chapter describes the meaning of the 71 billion m^3 of ‘virtual’ water that is imported into the Netherlands, annually, and gives an overview of the results of the study by Van Oel et al. (2008) that relates the Dutch ‘virtual’ water import to water scarcity.

It should be noted that the water footprint figures presented in that study were calculated using 7-to-12-year-old data on trade. As consumption patterns as well as the source of imported goods may change over such a time period, the information on the environmental impact related to the water footprint of Dutch consumption may not represent the current situation. Another reason to be cautious with this information is that the study by Van Oel et al. was one of the first water footprint assessments focusing on local impacts, and therefore was hampered by methodological limitations.

3.2 The Dutch water footprint indicators

The amount of ‘virtual’ water imported into the Netherlands was calculated at an annual 71 billion m^3 for the 1996–2005 period, which put the Netherlands in ninth place on the global list of major ‘virtual’ water importers (Mekonnen and Hoekstra, 2011; Hoekstra and Mekonnen, 2012a). This high place reflects the position of the Netherlands as a country of trade and transit of agricultural goods. Nearly 80% of the imported ‘virtual’ water was green water, about 7% was blue water and nearly 15% was grey water. Imported ‘virtual’ water was either directly forwarded in transit, consumed in the Netherlands, or processed and exported. Most of the imported ‘virtual’ water, 70% (49 billion m^3), was forwarded in transit or exported after processing, leaving 30% (22 billion m^3) of imported virtual water that was consumed within the Netherlands, also called the external water footprint of national consumption. Together with 4 billion m^3 of ‘Dutch virtual water’ for goods produced or processed in the Netherlands, an annual total of 53 billion m^3 of ‘virtual’ water was exported (49 billion m^3 plus 4 billion m^3). This leaves an annual net import of 18 billion m^3 of ‘virtual’ water (71 billion m^3 imported minus 53 billion m^3 exported).

The 22 billion m^3 of ‘virtual’ water that were imported annually into the Netherlands for national consumption during the 1996–2005 period made up the external water footprint of national consumption. Together with an internal annual water footprint of consumption of 1.3 billion m^3, this would add up to a total annual water footprint of Dutch consumption of over 23 billion m^3. This also implies that 95% of the Dutch water footprint of consumption was external. Of all EU Member States, the Netherlands had the highest ratio between external and total water footprint of consumption (Ercin et al., 2012). Yet, the Dutch water footprint of consumption per capita was only slightly higher than the world’s average, and for blue water the per-capita footprint of consumption was even below the world’s average. Within the EU, the Netherlands was among the 10 countries with the lowest per-capita water footprint of consumption.

Over 70% of the water footprint of Dutch consumption consisted of green water. Eighty-five per cent of the footprint was related to agricultural goods, nearly 15% to the consumption of industrial goods, and about 1% to domestic water use. Most agricultural products were related to food consumption, the most important exceptions being cotton (for textiles) and oil crops (Van Oel et al., 2008).

3.3 Environmental impact of the Dutch water footprint of consumption

Data on international trade are available on a country scale and do not relate to catchment areas. Therefore, they are not accurate enough to locate hot spots. For agricultural products, however, data on exports to the Netherlands can be supplemented with data on the location of certain crops in other countries and with data on net rainfall. These combined data may be used to carry out a risk assessment for the commodities that are likely to be imported from a hot spot area.

The water footprints of Dutch consumption over the 1996–2005 period were allocated to certain cathment areas and compared against local water availability (Van Oel et al., 2008). Nearly half of the Dutch water footprint of consumed agricultural products was located within Europe and 20% in Latin America, mainly in Brazil and Argentina (Van Oel et al., 2008). About half of the external Dutch water footprint of industrial products was in Europe and one third in Asia – mainly in China (including Hong Kong), Taiwan and Viet Nam. Countries with possible hot-spot areas were selected based on their share in the total external water footprint of Dutch consumption and the level of water scarcity in these countries. With the exception of China, the external water footprint in these countries was mainly due to agricultural products. In China, the water footprint to a large extent was related to the production of industrial goods for the Dutch consumer market. This footprint consisted mostly of grey water (90%), the remainder being blue water (10%). (Van Oel et al., 2008).

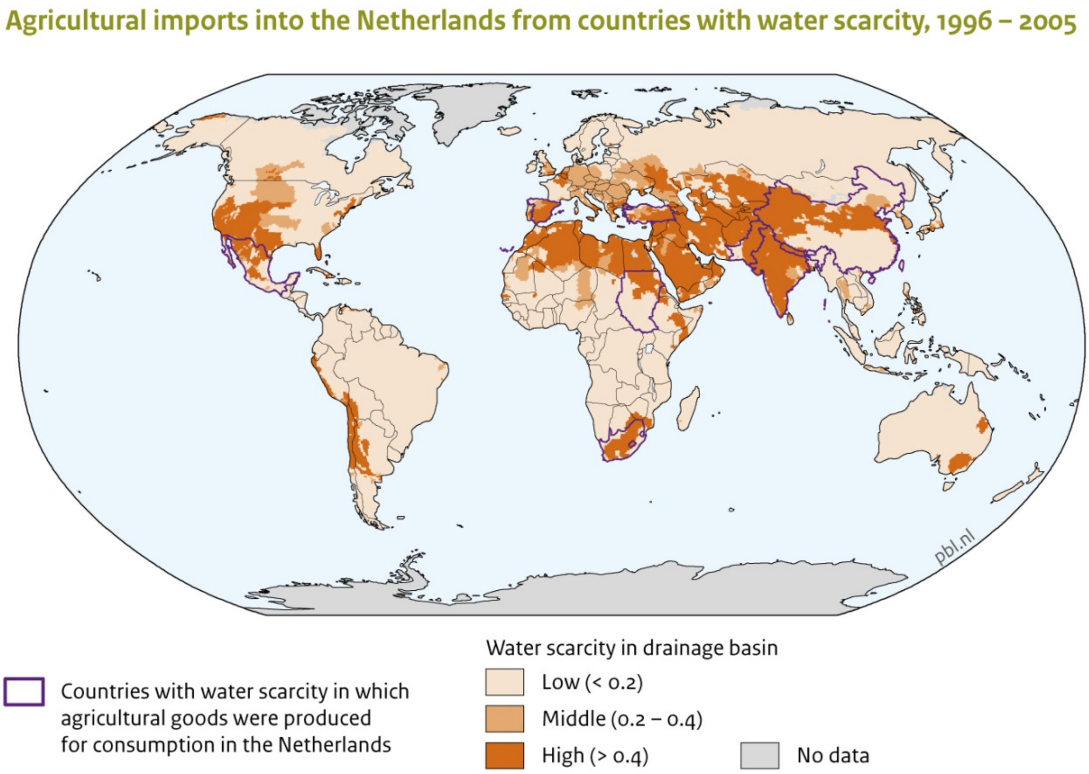

Figure 1. Agricultural goods with a large water footprint imported into the Netherlands from countries with water scarcity (data from 1996 to 2005). There is a risk of these imported goods being unsustainable. Sources: Van Oel et al. (2008) for data on water footprint and Smakhtin et al. (2004a and b) for data on water scarcity.

The sustainability assessment further focused on agricultural products imported for consumption in the Netherlands. Countries with severe water scarcity from which agricultural products with a large blue water footprint were consumed in the Netherlands were China (cotton), India (cotton, coffee, castor oil), Spain (fruit), Turkey (cotton, fruit, tobacco), Pakistan (cotton, sugar molasses), Sudan (sesame), South Africa (fruit, oil crops) and Mexico (coffee) (Figure 1). There are many examples of severe water problems caused by irrigated agriculture in these countries, but the geographical accuracy of the available data on trade do not allow the exact location of the blue water footprint of the Netherlands. This means that certain commodities with a high risk of having an unsustainable blue water footprint can be traced, but additional information from the companies concerned would be needed to exactly trace them to possible hot spots, thus, establishing their environmental impact.

3.4 Conclusions

Large water footprint of the Netherlands reflects a prominent position in the global agricultural market, not necessarily a large environmental impact

The large amount of 'virtual' water imported into the Netherlands reflects the country's prominent position in the global agricultural market. The Netherlands, through the import, export and transit of goods, is connected to many supply chains with large water footprints. This large amount of imported 'virtual' water does not necessarily reflect an unsustainable situation. About 7% of the total import of 'virtual' water was blue water, which represents a risk of being unsustainable and about 15% was grey water, which represents pollution.

For its own consumption, the Netherlands imported goods with a large blue water footprint from countries with water scarcity, according to data over the 1996–2005 period. Imports from these countries may have caused the blue water footprint of Dutch consumption for this period to have been partly unsustainable. However, data on trade are not focused enough, geographically, to trace the Dutch footprint exactly to any unsustainable hot spots. To be able to do so, additional information would be needed from the producing companies concerned.

4 Strategies to reduce the environmental impact of a water footprint

4.1 Introduction

The Water Footprint Assessment Manual of the Water Footprint Network (WFN) provides response options on different strategic levels to tackle water problems connected to water footprints (Hoekstra et al., 2011). Formulating response options is done in Phase 4 of the water footprint assessment. The manual groups the options per actor: consumers, companies, farmers, investors and governments. This chapter describes a strategic framework that could be used to systematically formulate policy options to reduce environmental impacts related to a water footprint, based on Van Oorschot et al. (2012). The actors that are directly responsible are mentioned, but in an indirect way more actors are also involved, such as investors and NGOs. Chapter 5 provides an overview of the most important actors.

4.2 Environmental impacts of a water footprint

The main environmental impacts related to a water footprint are listed below:

1. For blue water, the environmental impacts may be reduced river discharges, reduced water levels in rivers and lakes, reduced groundwater levels, and a reduced capacity to assimilate pollutants emitted to water. This, in turn, would lead to a reduced availability of good quality blue water to other users and the ecosystem; the latter may affect the delivery of ecosystem goods and services to humans.
2. For green water, when it is used by water-intensive crops evaporating more than the natural vegetation, the environmental impacts may be a reduced run-off and infiltration, leading to a reduced availability of blue water with effects as described above.
3. For the emission of pollutants to water, the environmental impacts may consist of the pollution of surface water and groundwater, leading to human health risks and possible degradation of ecosystems and their goods and services provided to humans.

All these impacts, together, lead to problems of water quantity and quality, and impact humans and ecosystems, worldwide. According to the OECD Environmental Outlook to 2050 (OECD, 2012), increasing water demand will exacerbate water stress in many river basins, particularly in densely populated areas in rapidly developing economies. More river basins are projected to come under severe water stress by 2050. The number of people living in stressed river basins is expected to increase from 1.6 billion in 2000 to 3.9 billion by 2050, equalling over 40% of the world population of 2050. By then, almost the entire population of South Asia and the Middle East and large shares of the population of China and North Africa are expected to live in river basins under severe water stress.

In many regions of the world, groundwater is being exploited faster than it can be replenished, leading to increasing groundwater depletion. Gleeson et al. (2012) estimated that the size of the global groundwater footprint is currently about 3.5 times the actual area of aquifers, and that about 1.7 billion people live in areas where groundwater resources are under threat. They found over 20% of groundwater aquifers to be overexploited.

The quality of surface water is expected to deteriorate in the coming decades, caused by different groups of pollutants, such as micro-pollutants, pesticides and nutrient overloads from agriculture and poor wastewater treatment. The OECD Environmental Outlook to 2050 (OECD, 2012) assessed the consequences of nutrient overloads, which were found to be increased eutrophication, biodiversity loss and disease. For example, the number of lakes at risk of harmful algal blooms is expected to increase by 20% in the first half of this century. The occurrence, frequency, duration and extent of oxygen depletion and harmful algal blooms in coastal zones are projected to increase as rivers discharge rapidly increasing amounts of nutrients into the sea. Harmful algal blooms may damage ecosystems, fish stocks and fishery opportunities, and pose a danger to human health.

A water footprint assessment does not cover all water-related problems connected to production processes, as it only addresses water use in volumes and water pollution. For instance, the impact of production processes on river discharge patterns and flooding, and the morphological changes, such as dams and canalisations, are not assessed. The timing and duration of flow events and draughts are just as important for people and ecosystems as are average discharges. Low-flow periods are of critical importance for water availability, especially in dry areas, but equally so in temperate zones such as the Netherlands. Hoekstra et al. (2012) developed a method to include temporal aspects in their comparisons between blue water use and water availability at a monthly basis for the world’s major river basins. Effects of climate change on availability, in time and place, of green and blue water could be included in a water footprint sustainability assessment.

Furthermore, the issue of people lacking access to safe drinking water and adequate sanitation, as mentioned in the Hachchi–Ferrier resolution, is not addressed in the water footprint approach, since this often does not concern physical (blue) water scarcity, but economic water scarcity (Rijsberman, 2006; Molden, 2007).

The severity of the environmental impact related to a water footprint component depends on the size of the footprint and its spatial and temporal context. It is determined by the contribution of the footprint component to water stress or pollution in the related catchment and sub-catchment areas compared to the overall degree of water stress or pollution. Often, multiple users are responsible for water stress and pollution in those areas; this implies that reducing the size of those footprint components related to water stressed or polluted areas often is not enough to solve the existing water problems. To achieve a significant reduction in water stress or pollution in catchment and sub-catchment areas, often a more comprehensive approach is needed, involving all major water users in those areas.

4.3 Four strategies to reduce environmental impacts related to a water footprint

The impacts related to a water footprint may be reduced along the following complementing strategies (Figure 2):

1. *Impact reduction by consumers:* Reduce consumption or replace products with sustainable alternatives, and change human behaviour towards saving water and reducing pollution.
2. *Impact reduction by producers:* Increase resource efficiency along production and supply chains to reduce water use and emissions to water. Maximise the use of rain-fed crops. Use crops that need less water, fertiliser and pesticides.

3. *Impact reduction by water management authorities and producers:* Manage drainage basins according to the principles of Integrated Water Resource Management (IWRM), reduce local impacts or relocate production.
4. *Impact reduction by producers and environmental authorities:* Prevent or regulate the use of hazardous material in products and production processes to reduce the risk of toxic emissions to water.

There are synergies and trade-offs with the ecological footprint, as described by Van den Berg et al. (2011) and Van Oorschot et al. (2012).

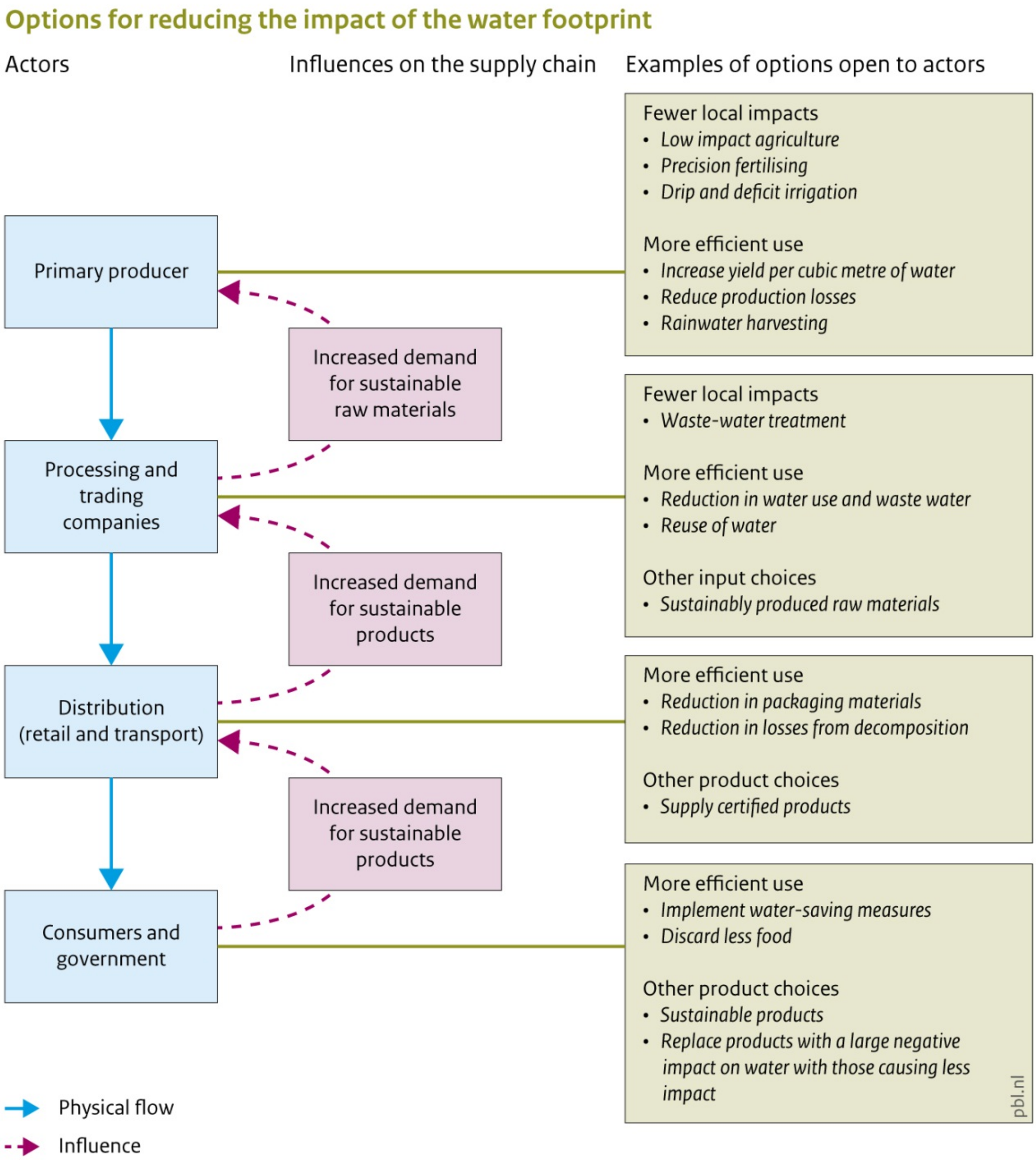

Figure 2. Options to reduce the negative impacts related to a water footprint can be found in all steps along the production and supply chains. Source: Van Oorschot et al. (2012, revised)

4.4 Conclusions

Options are available for reducing impacts on water used along supply chains and in catchment areas, as well as for general policies
Not all environmental impacts are addressed using a water footprint approach. The time dimension of water use and availability is just as important as the spatial dimension.

Demand for sustainable products may cause a multitude of actions down the supply chain to reduce the environmental impacts of products. This could be further supplemented by general policies aimed to reduce the risk of toxic pollution and by local policies aimed to optimise water management in the catchment and sub-catchment areas where the production processes take place.

5 Actors that influence water footprints or water footprint approaches

5.1 Introduction

The overall picture of actors, coalitions and networks involved with water footprints is complex and confusing. There are several networks that are related to water footprint approaches and many related to sustainable water management. They have various compositions and often overlapping goals. Network members are often involved with more than one network. Recent networks have been adding up to and are sometimes interwoven with the networks around water management that already have a longer history and establishment. Other networks focus on sustainable production and supply chains and address water as one of the issues. Although the term ‘water footprint’ is not always mentioned in descriptions of goals and tasks of networks, ‘water footprint thinking’ is effectively addressed if water use and emissions to water in the supply chain are included.

Actors involved with water footprint approaches all have their own interests and motives, mandates and room to move. There seem to be two basic motives for being involved with water footprint approaches: 1) to create a sustainable world, and 2) to be able to produce and make a profit, also in the long run. These two motives also apply to the concept of ‘Green growth’. For the Dutch Government to be able to capitalise on these motives and many initiatives and networks to promote sustainable water use, an overview and understanding of these actors and networks and their motives would be required. A selection of actors and networks is described below. An in-depth investigation would be required to analyse the actual roles of these actors, all interconnections between them, and the efficiency of the total complex of networks to develop, promote and implement water footprint approaches and make water use sustainable. Such an analysis was beyond the scope of this study.

5.2 The supply chain

Actors in the supply chain are key to reduce water footprints and related environmental impacts. Only if they would change their behaviour and habits, the production and supply chain could be transformed into a sustainable process. A supply chain starts with a primary producer and ends with a consumer. In a supply chain, many different actors are connected to each other; primary producers such as farmers, producers of fertilisers and seeds and semi-manufactured and end products, packers, professional buyers and retailers, investors and transporters. Furthermore, at every point along the supply chain where goods are being produced or processed while using or polluting water, there is a connection with local or national authorities and other users of the same water resources.

Authorities and stakeholders in ‘hot-spot’ catchments
Boundary conditions regarding the use and pollution of water resources are set by the local context at the locations of production and processing involved in the supply chain. In unsustainable hot spots, where water is scarce and water quality does not meet the standards, choices have to be made about water allocation and other water issues, and about the measures to be implemented. Ideally this is done by the authorities responsible and local parties involved in cooperation with companies with a water footprint in those catchment and sub-catchment areas. However, the water footprint or ‘virtual water’ concept, so far, has hardly been part of

integrated water resource management, national water plans or river basin plans (Postle et al., 2011). Moreover, scenarios on future water demand, allocation and pollution and their effects need to be considered, as well as the potential impacts on water availability of climate change, urbanisation, deforestation and other land-use changes. Companies with a footprint in the catchment and sub-catchment areas and local actors share an interest in and responsibility for good water management in those areas.

Businesses

Because of an increase in scale, the power in supply chains is more and more concentrated at ever-expanding companies that are in a position to set standards and determine prices (Backus et al., 2011; WWF, 2012c). In supply chains, manufacturers usually have the largest profit margins and farmers the lowest. Manufacturers and retailers can sell the 'sustainability' of their products as a trade mark, whereas farmers usually are anonymous. This makes manufacturers more powerful than farmers to make production and supply chains sustainable. Retailers have a key position, as they can select sustainable products and set standards down the supply chain on the one hand, and influence consumers by 'choice editing' up the supply chain on the other. Supermarkets in the Netherlands, for instance, obtain all their products from only five professional buyers, so together these actors could exert a great influence on the supply chain (Backus et al., 2011; PBL, 2012). Farmers depend on cooperation in the supply chain to sell the sustainability of their products. They usually also depend on the supply chain for investments in innovations aimed at increasing sustainability, as they lack the capital needed.

Because of the strong competition and the weak position of farmers in the supply chain, prices for their products are low and there is pressure to produce more efficiently and on a larger scale. This makes their farms more capital-intensive and dependent on external financing by investors. Investors, on the one hand, may stimulate water footprint assessments to make footprints sustainable, because these assessments may help to reduce risks, whereas, on the other hand, investments in more sustainable production methods carry the risk of products not selling due to their higher prices, which especially is a problem on a farmers level where margins already are low.

Companies have become aware of the indirect water use connected to the ingredients that they use for their products, among other things because of the introduction of water footprint approaches. They are usually not interested in the size of their water footprint as such, but in water use efficiency, particularly related to blue water, and the environmental impact of their footprint. By comparing efficiencies with others through benchmarking, companies may be able to determine where improvements could be made. The reasons for being interested in their water footprints may vary and include, for instance, corporate social responsibility, reduction in negative impacts on the environment, creation of a better reputation by demonstrating good stewardship, attracting more clients and investors, using water footprint information on lables to indicate quality and getting a better price for certified products, setting standards, having competing advantages as a front runner, enabling identification of areas to reduce water use and include less water-intensive products, reduce risks, avoid fines, experience less legal enforcement and reduce costs (Postle et al., 2011). However, a recent survey about the application of water footprint methods held among companies showed data gaps and uncertainty to be huge problems (Postle et al., 2011). For example, companies often were found able to measure their own operational water use, but gathering data on supply chain water use was problematic, and the use of global average data would mean that they could not distinguish themselves from other companies. Grey water footprints were difficult to assess, according to these companies, as data were lacking on emissions, on the water quality of the receiving water body and on the desired surface water quality along the supply chain.

To date, the food and beverage sector has been the most active sector in water footprint studies, but this is changing as more companies understand the importance of addressing water issues as part of sustainability strategies. Water footprint assessment is primarily used to get an insight into the largest components and locations of water use and pollution along the supply chain. This enables companies to improve their understanding of the associated risks and to design water management strategies, make investment decisions and improve production processes (Appendix 3).

Unilever

In their Sustainable Living Plan, Unilever aims to reduce the water footprint of their products (Unilever, 2010, 2011, 2012). This concerns the whole production and supply chain from growing crops, processing in Unilever factories and the consumer use of Unilever products. Concrete goals are to halve the amount of water associated with the consumer use of Unilever products by 2020, and to bring water abstraction of the Unilever factory network at or below 2008 levels despite significantly higher production volumes, while focusing in particular on factories in water scarce locations. The Unilever Sustainable Agriculture Programme helps farmers to reduce their water use (Unilever, 2012). Using data from the Water Footprint Network, Unilever estimated the water requirements of their key crops. It uses these data to identify locations with the biggest risks of water problems and to develop plans with suppliers and growers. Unilever states that it is making steady progress with its key suppliers, whose use of drip irrigation has increased from 39% in 2009 to 52% by the end of 2011 (Unilever, 2011). Unilever also has added water footprint data in their communications (Unilever, 2010, 2011). These data, however, only refer to the amount of water added to the product, – the direct water use – plus the water used by consumers in water-scarce countries (China, India, Indonesia, Mexico, South-Africa, Turkey and the United States). Any indirect water use along their supply chains, the core idea of 'water footprint thinking', is not being reported on.

Consumers

The largest part of the water footprint of Dutch consumption is related to agricultural products, mainly food. Consuming less food and less animal proteins would benefit the health of many consumers in the Netherlands and would lower the ecological and water footprints of their consumption (Westhoek et al., 2011; Health Council of the Netherlands, 2011). Households in the Netherlands could save an annual 325 euros, on average, if they would not throw away any food (Backus et al., 2011). However, consumer habits are difficult to change. Consumers mostly choose their food products out of habit and this in turn depends strongly on their social environment. Consumers are however increasingly aware of the sustainability aspects that are connected to food. Retailers try to meet this growing awareness by providing informative labelling. There is a strong need for a better overview of and uniformity in labels, as well as insight into the meaning of certain indications on labels (PBL, 2012). An educational campaign focused on health and environmental aspects of food would be even more appropriate according to Postle et al. (2011). The Ecolabel Index provides an overview of ecolabels, but seems to be targeted at companies rather than consumers (Ecolabelindex 2012) (see Section 5.6).

Round tables

A number of round-table and comparable business initiatives are addressing sustainable production and supply chains for various products (Appendix 4). All these initiatives, to a greater or lesser extent, address water-footprint-related issues that are incorporated in standards and certification schemes. Explicit references to water footprints are only made in three cases, namely those of Textile Exchange, the Beverage Industry Environmental Roundtable (BIER) and the European Food Sustainable Consumption and Production (SCP) Round Table.

5.3 Non-governmental organisations

Non-governmental organisations (NGOs) use the water footprint indicator to raise awareness about unsustainable consumption and production, to reach their goal of a sustainable world. Several NGOs have formed partnerships with companies to implement water footprint assessments and test and improve the methods.

World Wide Fund for Nature

The Word Wide Fund for Nature (WWF) has been very active in promoting the water footprint indicator (WWF, 2012b/c/d). It has participated in pilot studies and the development of methods and tools. However, in its communication, WWF usually does not mention that the water footprint indicator does not reflect environmental impacts or unsustainability. WWF is one of the seven founders and a sponsoring partner of the Water Footprint Network (WFN, 2012) and of the Alliance for water stewardship (see Section 5.6).

The Nature Conservancy
The Nature Conservancy (TNC) also is actively involved with water footprints. TNC is working with members of the Water Footprint Network (WFN) to innovate methodologies to track down ‘hidden water’ and help farmers and corporations find ways to use less water in the process of growing crops and manufacturing products (TNC, 2012). TCN was one of the first partners in the Water Footprint Network and is now acting as a sponsoring partner (WFN, 2012).

NGOs, WWF and TNC, all endorse the CEO Water Mandate (see below). WWF has been involved in pilot projects on water footprint applications with SABMilller and Nestlé, TCN in pilot projects with Jain Irrigation Systems and The Coca-Cola Company (Appendix 3).

SABMiller

SABMiller, a global brewer, aims at ‘making more beer but using less water’ (SABMiller, 2010, 2011, 2012). Water scarcity is recognised as a significant risk to parts of their business, as well as to some of the communities in which they operate. SABMiller aims to collaborate with local communities to protect the watersheds that they share. Within its breweries SABMiller aims to use water as efficiently as possible and to reduce water use per hectolitre of beer by 25% between 2008 and 2015. The reduction realised in 2010/2011 was 8%. SABMiller started in cooperation with WWF and since 2009 has been working with WWF and German international development agency GIZ in the ‘Water Futures Partnership’ (SABMiller, 2011; WFP, 2012). Under the flag of this partnership, local projects on water scarcity and pollution concerning groundwater and surface water in Peru, South Africa, Tanzania, the Ukraine, Colombia, Honduras, India and the United States are being carried out or will be started. In a number of projects, the first phase consisted of a ‘water footprint study’ focused on water use in beer production from crop cultivation to waste disposal, followed by a detailed ‘watershed risk and sustainability assessment’ and ‘business water risk assessment’. The search for and realisation of response options is done in cooperation with local stakeholders (government, other companies and NGOs). A number of projects already have had concrete results.

Global Reporting Initiative
The Global Reporting Initiative (GRI) is a non-profit organisation that promotes economic, environmental and social sustainability (GRI, 2012). The GRI provides all companies and organisations with a comprehensive sustainability reporting framework. The framework enables organisations to measure and report their economic, environmental, social and governance performance.

In GRI’s current Sustainability Reporting Guidelines (version 3.1), water is one of the ‘Environmental Aspects’, with indicators for direct water use and pollution (GRI, 2011). However, the guidelines do not consider water footprints or supply-chain aspects.

Carbon Disclosure Project
The Carbon Disclosure Project (CDP) is an independent non-profit organisation working to stimulate greenhouse gas emission reductions and sustainable water use by businesses and cities. The CDP receives funding support from a wide range of organisations (CDP, 2012a), such as the Nathan Cummings Foundation, the Esmée Fairbairn Foundation and governments of various countries including those of the United Kingdom, the United States, Sweden, France and the Netherlands. Since 2010, the CDP has sent an annual water questionnaire to the world’s largest companies in the industrial sectors that are water-intensive or are particularly exposed to water-related risks in their production and supply chains. In 2012, the information request was formally supported by 470 investors representing USD 50 trillion in assets and was sent to 318 companies. The response that was received from 191 companies (60%) was used for the ‘CDP Global Water Report 2012’ (CDP, 2012b). One of the main findings of that report was that there had been a marked increase in awareness of water risks in the supply chain, with 71% of respondents now able to state whether or not they were exposed to such risks (up from 62% in 2011).

5.4 European Union

Sustainable production and consumption are targets of the EC communication 'A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy' (EC, 2011a). Water is named as one of the threatened resources, and resource use efficiency issues should be addressed, internationally, according to the European Commission's communication. The EC communication also states that, in order to monitor progress, 'indicators are needed to cover issues such as the availability of natural resources, where they are located, how efficiently they are used, waste generating and recycling rates, impacts on the environment and biodiversity'. The water footprint is mentioned as an optional indicator for global resource demand in the consultation paper about options for Resource Efficiency Indicators. From consumption and global supply chain perspectives, the water footprint – yet to be updated and improved – is mentioned as a potential indicator (EC DGEnvi, 2012).

In their Resource Efficiency Roadmap (EC, 2011b), the EC has attributed an important role to 'environmental footprints' in the following actions:

- Establish a common methodological approach to enable Member States and the private sector to assess, display and benchmark the environmental performance of products, services and companies based on a comprehensive assessment of environmental impacts over the life cycle of products ('environmental footprint') (in 2012);
- Ensure better understanding of consumer behaviour and provide better information on the environmental footprints of products, including preventing the use of misleading claims, and refining eco-labelling schemes (in 2012).

To shape these actions, the EC initiated the development of a harmonised European methodology for environmental footprint studies for products and organisations, based on existing Life Cycle Assessment approaches (EC et al., 2012a, 2012b). The main requirements of the methodology for products includes water quality aspects; water quantity aspects are additional, depending on the product. The methodology for organisations only refers to water quality aspects, although data on water input and output also should be collected. The methodology does not refer to 'virtual' water and water footprint approaches, or to the Water Footprint Assessment Manual. Nor does it refer to the assessment (also financed by the European Commission) of the efficiency of the water footprint approach and its application in agricultural products and foodstuff labelling and certification schemes by Postle et al. (2011). It is also unclear how the proposed methodologies relate to other international initiatives, such as those proposed by the Sustainability Consortium described in Section 5.6.

5.5 Multilateral organisations

Multilateral organisations have a role and interest in stimulating resource efficiency and sustainable use of natural resources. Their role is to set global goals, develop policies and agreements, and stimulate the implementation of these policies and agreements as financier, facilitator or legislator. Finally, they have a role in controlling, monitoring and evaluating policies. The water footprint approach could be considered in all policy phases.

United Nations

Water footprints receive increasing amounts of attention in the UN World Water Development Reports (WWDR, 2006, 2009, 2012). The fourth edition also included the expectation that a water footprint measure would likely be available and published on an annual basis between 2020 and 2030. In UNEP's operational freshwater strategy of 2012, one of the priority actions was to further develop harmonised international methodologies that quantify and account for water use; for example, by refining water accounting and footprint techniques (UNEP, 2012). UNEP is also one of the sponsoring partners of the Water Footprint Network (WFN, 2012).

CEO Water Mandate

In July 2007, the CEO Water Mandate was launched by the UN Secretary General under the flag of the UN Global Compact. The Global Compact is a strategic policy initiative for businesses that are committed to aligning their operations and strategies with ten universally accepted principles in the areas of human rights, labour, environment and anti-corruption (UNGC, 2012). Objectives are to mainstream the 10 principles of business activities around the world, and to catalyse actions in support of broader UN goals, including the Millennium Development Goals (MDGs).

The CEO Water Mandate was designed to assist companies in the development, implementation and disclosure of water sustainability policies and practices (UNGC, 2012; TCWM, 2012a). The Mandate recognises the impact of the business sector on water resources through the production of goods and services, both directly and via supply chains – an idea that closely relates to the water footprint concept. CEOs of endorsing companies have acknowledged their responsibility to make water resource management a priority, and to work with governments, UN agencies, NGOs and other stakeholders, to address this global water challenge. The mandate, among other things, covers the topic 'supply chains and watershed management'. Endorsing companies are required to report annually on their implementation progress in the annual Communications on Progress for the UN Global Compact.

The mandate organisation has released a draft of Corporate Water Disclosure Guidelines in order to offer a common approach for companies to report on water (TCWM, 2012b). Some of the Advanced Reporting Practices are the result of a detailed assessment of water stress and other context factors in 'hot-spot' basins regarding direct operations as well as the supply chain. By building on earlier standardisation processes developed by organisations such as the Carbon Disclosure Project and the Global Reporting Initiative (see Section 5.3), the guidelines aim to support and inform existing and emerging work in the field of corporate sustainability, in addition to supporting the companies' water-related disclosure. Various tools to support reporting practices are listed, including those of the Water Footprint Network.

Currently, there are 86 companies endorsing the mandate, including AkzoNobel, DSM, Heineken, Shell, Philips and Unilever, with 49 companies having delivered a 'Communications on Progress – Water' (TCWM, 2012a). However, these are only a few of the more than 8700 corporate participants and other stakeholders in the Global Compact. A minority of companies involved in water footprint studies are also endorsing the Mandate (Appendix 3).

International Finance Corporation

The International Finance Corporation (IFC) of the World Bank Group is one of the seven founders and sponsoring partner of the Water Footprint Network and one of the founders of the 2030 Water Resources Group that launched 'Charting our water future' (Appendix 5) (2030WRG, 2012). In collaboration with Jain Irrigation Systems, the IFC also carried out a pilot study on water footprints (Appendix 3). Since 1 January 2012, the IFC has been using a Sustainability Framework that applies to all investment advisory clients whose projects go through IFC's initial credit review process (IFC, 2012a). The Framework consists of Performance Standards and accompanying Guidance Notes (IFC, 2012b). Water use and pollution are mentioned in Performance Standard 3 - Resource Efficiency and Pollution Prevention. However, this only refers to the direct use of water; supply-chain aspects related to water are not covered, in contrast to other aspects described in Performance Standard 2 'Labor and Working Conditions' and 6 'Biodiversity Conservation and Sustainable Management of Living Natural Resources'.

Organisation for Economic Co-operation and Development

The Organisation for Economic Co-operation and Development (OECD) has developed guidelines for corporate responsibility, the 'OECD Guidelines for multinational enterprises' (OECD, 2011b). These involve far-reaching recommendations for responsible business conduct, endorsed by 44 governments who encourage their enterprises to observe these recommendations wherever they operate. These governments represent all regions of the world and account for 85% of foreign direct investment. In the 2011 edition, new guidelines were added that promote responsible dealing with natural resources along the supply chain (OECD, 2011a). In the guidelines, water is only mentioned in one passage on local communities. Nothing is said about responsible management of water resources in drainage basins with water scarcity, although 'responsible dealing with natural resources' could be interpreted as such.

Jain Irrigation Systems

Jain Irrigation Systems (Jain), a transnational company with its head offices in India, is a manufacturer of irrigation systems and several other products including processed fruits and vegetables (Jain, 2012). The company is known for its drip irrigation (micro-irrigation) systems which they claim saves up to 70% in water compared to furrow irrigation. Drip irrigation was identified in the report 'Charting Our Water Future' by the 2030 Water Resources Group as an important measure to address current and future water scarcity in India (2030WRG, 2009). Jain is active in the sustainable water management of its own operations as well as those of its customers and suppliers of agricultural products. An appealing example in this respect is the Jain Watershed project that transformed an area from a barren hill to a green zone (Jain, 2009; Larson et al., 2010).

In 2010, the World Bank's International Finance Corporation (IFC) and Jain, with support from The Nature Conservancy and LimnoTech, and with financial support from the Dutch Ministry of Foreign Affairs, conducted a water footprint assessment of dehydrated onion products (Larson et al., 2010). It was a full water footprint assessment, with an accounting of water consumption followed by a sustainability assessment and the formulation of response strategies on the groundwater overdraft in the area concerned. The response strategies that were identified were an increased use of drip irrigation by onion farmers, support for the regional government of Maharashtra, India, who pushed for new, less water-intensive cropping strategies in the area, encouraging rainwater harvesting and aquifer recharge projects and supporting or establishing a dialogue through which representatives of local water stakeholders, including businesses, government and NGOs, could work together toward sustainable water resource management. In 2011, Jain was one of the 16 emerging-market-based companies designated 'New Sustainability Champions' by the World Economic Forum (WEF, 2011).

5.6 Networks

Networks are essential for sharing knowledge and progressing towards shared goals while creating broad support. Many networks have been formed to address issues around integrated water resource management, sustainable production and supply chains, water footprints, water and multi-criteria sustainability standards, good water stewardship and the development of tools and methods to support all these goals. There is a multitude of networks with overlapping goals and members participating in several networks in varying combinations. The list of networks described below is far from complete. The networks are mentioned either because of their role in the development of the water footprint concept, or because they have a leading role in the development of water management or sustainable production and supply chain concepts. Some of these networks were found not to pay any attention to water footprint aspects.

Water Footprint Network

The Water Footprint Network (WFN) was founded in 2008 to promote the transition towards sustainable, fair and efficient use of freshwater resources worldwide by advancing the concept of the 'water footprint', increasing awareness of the water footprint among communities and government bodies, and encouraging forms of water governance that reduce the negative ecological and social impacts related to the water footprints of communities, countries and businesses (WFN, 2012). To that end the WFN undertakes a series of concrete activities, such as developing standards and tools, organising meetings, publications, education, research and development, promoting the exchange and dissemination of knowledge about water footprint approaches, supporting organisations in implementing water footprint assessments and providing advice. The WFN was founded by 7 partners. On 16 October 2010, the network already had 130 partners, a number that grew to 187 in 2012, and currently includes companies, NGOs, international organisations and networks, research institutes and universities. The WFN developed the Water Footprint Assessment Manual (Chapter 2) (Hoekstra et al., 2011).

C&A

A major part of the corporate responsibility policy of fashion company C&A is good water stewardship, in the context of which C&A is currently implementing a zero tolerance policy regarding hazardous chemical discharges associated with any link in their production and supply chain and the life cycles of their products (C&A, 2012a). C&A is a sponsoring partner of the Water Footprint Network (WFN). The WFN helps C&A to chart the water footprint in their global supply chain in an effort to identify the main hot spots in terms of the most water-intensive and water-polluting processes, as well as the geographic locations at which such processes take place (C&A, 2012b). In a separate study conducted by the WFN and financed by C&A, the grey water footprint as an indicator for water pollution was studied, comparing organic and conventional cotton cultivation in India. The results of this study clearly favoured a wider implementation of organic cotton cultivation, given that pesticides used in the cultivation of conventional cotton agriculture were found to be the main pollutant on most of the conventional farms. C&A has agreed to further funding of a study aimed at a more detailed analysis of conventional and organic farming practices and their impacts on water quality. The outcomes of this project can be used to train farmers how to reduce water pollution that originates from their fields. These additional results should be ready for presentation in the second half of 2012. Subsequently, C&A and the WFN will start to identify various policy options, which will help C&A to address those hot spots, with the intention of reducing their overall use of water and water pollution.

Global Water Partnership

The Global Water Partnership (GWP) was founded in 1996 by the World Bank, the United Nations Development Programme (UNDP), and the Swedish International Development Cooperation Agency (SIDA) to foster integrated water resource management (IWRM) (GWP, 2012a). The network is a non-profit action network with over 2,550 partner organisations in 161 countries around the world, with 80 Country Water Partnerships and 13 Regional Water Partnerships. The Netherlands is one of the financial supporters of the network. The GWP developed a toolbox to support IWRM. The toolbox pays only limited attention to supply chain aspects and water footprints.

Alliance for Water Stewardship and European Water Partnership

The Alliance for Water Stewardship (AWS) was formed because of a need for a coherent international framework for responding to freshwater challenges (AWS, 2012a). The AWS board consists of members from 10 non-profit organisations, including The Nature Conservancy, World Wide Fund for Nature, European Water Partnership and the CEO Water Mandate. The AWS is funded by a mix of organisations, companies, NGOs and governmental organisations, and is also a sponsoring partner of the Water Footprint Network. The AWS centre piece is the development of an International Water Stewardship Standard (AWS, 2012b/c) (see also Chapter 6).

Included in the AWS are a number of regional initiatives. Although already existing before the AWS was formed, the European Water Partnership (EWP) is now recognised as one of these initiatives and is an active member of the AWS Board of Directors. The EWP is a network of representatives from industries, governments, NGOs and research institutes. The ultimate goal of the EWP is to elaborate strategies and implement concrete actions to achieve the objectives of its Water Vision for Europe (EWP, 2011). This Water Vision for Europe mentions transparency about water footprint practices of individual, industrial, agricultural and local authorities and those related to products, as useful instruments in achieving a modern water-efficient society. The EWP has developed a European Water Stewardship standard (EWS) for businesses and agriculture to assess, verify and communicate sustainable water management practices at operational and river basin levels.

The Netherlands Water Partnership

The Netherlands Water Partnership (NWP) is a network within the Dutch water sector and one of the seven founders and sponsoring partner of the Water Footprint Network. It is active in the European Water Partnership.

World Business Council for Sustainable Development

The World Business Council for Sustainable Development (WBCSD) is an organisation of 200 forward thinking companies that intends to stimulate the global business community to create a sustainable future for businesses, society and the environment. The council provides a guide for businesses to help them manage water more sustainably by providing them with an overview of water tools and initiatives which they can use or engage in (WBCSD et al., 2012). Among these initiatives are Water footprint and LCA methods. The WBCSD also addresses corporate water risks, and it is one of the seven founders as well as sponsoring partner of the Water Footprint Network.

Sustainability Consortium

The Sustainability Consortium is an international network of companies, consultancies, NGOs and research institutes (TSC, 2012). It is developing a standardised framework for the communication of sustainability-related information throughout the product value chain. The framework, called the Sustainability Measurement & Reporting System (SMRS) is to be used by companies to measure and report on product sustainability. It will enable the realisation of product-level Life Cycle Assessments and provide a platform for sustainability-related data sharing across the supply chain. Water quality issues will also be addressed as these form a standard component of LCAs.

Ecolabel Index

Ecolabel Index is a website developed and maintained by a network of NGOs and research institutes. According to its website, Ecolabel Index manages the largest global directory of ecolabels, currently tracking 432 ecolabels in 197 countries and 25 industrial sectors (Ecolableindex, 2012). Among the labels are multi-criteria labels as well as those focusing on a single issue, such as energy. Some labels are targeted at water use.

5.7 Conclusions

Large companies and local actors and authorities at footprint locations are crucial actors for making water use sustainable

There is a growing public awareness that current consumption and production patterns globally lead to unsustainable situations, damage to ecosystems and society, and risks for the future. 'Water footprint thinking' is part of this movement. From the perspective of water resource management, sustainable production and supply chains, good water stewardship, corporate social responsibility, corporate risk management and certification, there is growing interest in 'water footprint thinking'. NGOs have played an important role in raising awareness and promoting the water footprint indicator. This has led to a complex web of increasing numbers of initiatives and networks with overlapping goals and sometimes the same participants. For newcomers, for instance, companies interested in their water footprint or water-related certification, it can be difficult to find their way around this web. The Water Footprint Network has a coordinating role in developing and promoting water footprint concepts and applications. There seems a world to gain by joining forces with initiatives in the fields of LCA, sustainable production and supply chains, and certification.

Production and supply chain assessments, in particular at company level, seem the most promising and effective to reduce water use and pollution. Power in supply chains is concentrated in ever bigger companies who are in a position to set standards. Retailers and professional buyers have key positions in supply chains as they stand between producers and consumers. They are a relevant target group to address for setting sustainability standards.

Changing consumption behaviour seems challenging. It is important that tools are developed to initiate changes in consumption patterns related to personal interests.

NGOs play a crucial role in raising awareness and stimulating initiatives for water footprint pilots and developing standards.

Public authorities have not been frontrunners in water footprint development, but nevertheless have a task in guiding the process. Local authorities, in particular, have a great responsibility in ensuring the sustainable use of water based on local knowledge. Regional and national authorities have an important role to play in addressing water-related issues in relation to landowners, producers and consumers.

6 Water footprint and certification

6.1 Introduction

Certification and labelling are potential instruments to promote sustainable water use and to reduce the impact related to the water footprint of organisations, products and consumers. Certification and labelling schemes are aimed to provide assurance that certain criteria are being met, with respect to production methods and product characteristics. This also includes schemes that operate within a supply chain – business to business – and those aimed at communicating product quality to consumers. Certification and labelling are essential communicative tools, as they reduce a complex set of criteria to a simple mark.

According to Richter (2009), there are two main reasons for a company to be involved in water certification:

1. to encourage water efficiency and good water management;
2. to support the corporate reputation regarding social responsibility and sustainability.

This chapter sketches the current situation with regard to water and the multi-dimensional certification of organisations and products, with an emphasis on Europe.

6.2 Certification of organisations

The Alliance for Water Stewardship is developing the International Water Stewardship Standard, a performance standard that can be used globally to certify certain water users who voluntarily practice sustainable water management (AWS, 2011, 2012b/c). The first draft of the standard was open to public consultation until 15 June 2012. The first full version of the standard is targeted for mid 2013. Supply chain and water footprint aspects are part of step 6 of the draft standard 'Measure And Manage The Site's Indirect Water Use'.

The standard will be aimed at companies that use significant amounts of water in their operations and water utilities. To qualify for certification, applicants will be required to measure their direct and indirect water consumption and other physical and chemical characteristics in the drainage basins along their production and supply chains. The standard should not disadvantage small and medium-sized enterprises or enterprises in least developed countries. This means that any application of the standard should be both practical and feasible. The AWS is following the ISEAL Code of Good Practices, which is aimed to ensure that voluntary standards are effective and accessible and bring about positive social, environmental and economic effects (ISEAL, 2012). AWS intends to align the reporting component of its standard with indicators of the Global Reporting Initiative to the greatest extent possible (AWS, 2012a). Certification is possible at three performance levels with a per level increasing emphasis on supply-chain aspects.

Similar to the development of the International Water Stewardship Standard, the European Water Partnership has developed a European Water Stewardship (EWS) standard for businesses and agriculture to assess, verify and communicate sustainable water management practices at operational and river basin levels (EWP, 2011, 2012a/b). The standard is valid on a global scale, but based on local assessments with a focus on Europe. Supply-chain and water footprint aspects are covered by criterion 4.2 of the current version of the standard, stating that 'Water management in the supply chain shall be evaluated on long term.' and that 'The purchase of products and material from water sustainable suppliers shall be achieved over time according to the possibilities of the organisation'. Certification is possible at three performance levels that differ from those of the AWS standard. The EWP is currently implementing an operational certification system that demonstrates compliance with their standard.

6.3 Product certification and labelling

Information on water use and pollution included in product labels

Product labels are currently under discussion. Many existing certification and labelling schemes address environmental issues, but only a few include indirect water use and none cover the full life cycle of a product to reflect the total impact on water systems. There is currently no single scheme that addresses all of the water issues that would need to be covered. Furthermore, the University of Hertfordshire (UoH, 2010) found that the biggest driver of change was not the labelling itself, but consisted of the pressure along the supply chain; consumers have less leverage than large companies along the supply chain. Communication about environmental information to manufacturers, retailers and professional buyers ('business to business') may be better than that to consumers.

There is a distinction between certification and labelling schemes dealing with water issues that focus on the amount of virtual water embedded within a product (e.g. the water footprint indicator) and on schemes that focus on encouraging good water stewardship. The majority of food sector environmental labels are based on stewardship. Postle et al. (2011) concluded that labelling on the basis of a water footprint indicator is not currently recommended, given the issues surrounding the clarity, transparency and reliability of this indicator and its failure to address impacts on water systems. Current certification of water stewardship activities appears to be more appropriate for promoting and supporting change within industries and to encourage best practices, although it can be difficult to measure the ensuing environmental benefits.

Because of potential trade-offs between different aspects of sustainability and the risk of creating new problems in other fields when optimising water use, there is more value in creating a multi-dimensional sustainability label which brings together information from a range of sustainability criteria than a having on that just focuses on sustainable water use, although there is a certain tension between multi-criteria labelling and how such labels are understood by consumers.

Current EU schemes for food and agricultural products address a myriad of different issues and functions at different stages of food production and along the supply chain, as was found by Postle et al. (2011). The meaning of labels linked to certification is not always clear and standards differ greatly in terms of their level of quality control. As the number of certification schemes across Europe grows, it is increasingly important to ensure the comparability and accessibility of information coming from different sources. Currently, there is a lack of standardised methods to act as a basis for a multi-dimensional environment label. Ecolabel Index offers an overview of 432 currently used ecolabels in 197 countries by 25 industry sectors (Ecolabelindex, 2012).

EU Ecolabel

For non-food products the situation regarding product labelling in Europe is less confusing because of the existence of the EU Ecolabel (EU, 2012). In the context of a resource-efficient Europe, the voluntary EU Ecolabel has been developed for non-food products and services, based on Life Cycle Assessments. This label can be found on more than 17,000 products (situation in January 2012). It addresses aspects of water quality rather than quantity. In 2010, the EU Ecolabel Regulation was extended so that the labelling scheme would also cover food, drink and feed products. However, the desirability and feasibility of EU Ecolabels for these products have been judged questionable for several reasons. For instance, many stakeholders considered an Ecolabel in addition to existing labels for organic products as confusing to consumers, and especially if non-organic products should also get an Ecolabel. Also the costs for introducing and operating the label and consumer campaigns should be investigated first (Sengstschmid et al., 2011).

Nevertheless, a parallel development may result in some sort of certification and labelling scheme for food products for the EU. The European Food Sustainable Consumption and Production (SCP) Roundtable, co-chaired by the European Commission and food supply chain partners and supported by the UN Environment Programme (UNEP) and European Environment Agency (EEA) is in the process of identifying scientifically reliable and uniform environmental assessment methodologies for food and drink products, considering their significant impacts across entire product life cycles (FOODSCP, 2012a). This should result in the ENVIFOOD Protocol (Protocol for the ENVIronmental assessment of FOOd and Drink) (FOODSCP, 2012b). This protocol will follow the principles of Life Cycle Assessments (LCA) and will probably also include an impact-based water footprint as one of the indicators. In addition, tools and good practices of communicating the environmental performance of food and drink products and other relevant environmental information are being investigated (FOODSCP, 2011). Information on both products and organisations is included in the evaluation. Product information, for instance, refers to certification schemes, ISO labels and environmental footprints. Organisation-related information, for example, includes company-specific commitments and sustainability partnerships.

The ideal product certification scheme for water

Based on stakeholder consultation and literature, Postle et al. (2011) formulated the following key requirements of a certification scheme for water in a study for the European Commission. A certification scheme should:

- include outcome-based criteria, which means they should also reflect environmental impacts and not just efforts and behaviour;
- cover environmental, social and economic impacts;
- allow impacts to be assessed at the appropriate scale and at the right moment. Low-flow periods are often more important than mean annual estimates. ;
- be dynamic and adaptable to technological and methodological progress;
- review and, if necessary, update criteria to keep the scheme up to date;
- encourage demand along the supply chain by providing information needed by linked members in the supply chain;
- involve stakeholders in the set-up of the scheme, including the identification and agreement of criteria;
- be affordable and look for opportunities to deliver benefits to scheme members, such as through 'lighter touch' inspections by regulators in recognition of the commitment of members to achieve high environmental standards;
- avoid overlap with other schemes (cross-certification by these other schemes is allowed);
- avoid introducing new barriers to the market, for instance, for smaller and medium-sized enterprises and for producers in least developed countries;
- ensure certification is undertaken by a trustworthy third party;
- be transparent, provide the information needed by members, and based on a stewardship approach.

In addition, if water footprint aspects would be included in this certification scheme, it should also:

- consider indirect water use and pollution along the supply chain, as well as direct water use and pollution at production sites;
- locate hot spots (in space and time) of water problems along the production and supply chain and address cumulating competing claims on water resources within the drainage basins together with local parties and authorities concerned. Members of this certification scheme should be involved with integrated water resource management of these drainage basins.
- consider basic human needs related to water, as well as the needs of ecosystems at these hot-spot areas.

Finally, for a complete overview of environmental impacts, the scheme should:

- consider the whole life cycle of products, including their use by consumers and their conversion to waste after products are discarded.

6.4 Conclusions

Promising initiatives regarding organisation and product certification, but current situation still unsatisfying

Promising developments regarding certification of organisations on the basis of good water stewardship are the International Water Stewardship Standard that is being developed by the Alliance for Water Stewardship and an operational certification system for the European Water

Stewardship standard. However, rather than developing separate certification schemes for water, it is advisable to include water aspects in multi-dimensional sustainability standards.

Harmonisation of standards in the food sector is definitely needed, as there is a myriad of standards and labels, but not one of which completely addresses all targets of sustainable water use. The ENVIFOOD initiative looks promising and its progress could be monitored and stimulated. Although the European Ecolabel for non-food products, which is based on LCA, endeavours to become a standard on a European level, it does not include water quantity aspects.

7 Usefulness of water footprint for Dutch policy-making

7.1 Introduction

Instruments can be used in different phases of policy-making: defining problems, setting goals, developing strategies, defining target groups and actions, implementation, monitoring and evaluation. For this chapter, we explored the extent to which the water footprint would be useful in the different phases of policy-making in the field of sustainability, looking at the water footprint indicator and water footprint sustainability assessment (see Section 2.4 for a description of both instruments). Furthermore, different angles are described for Dutch policies to stimulate sustainable water use in product and supply chains. Preceeding this exploration, we first needed an overview of Dutch sustainability policies for which the water footprint approach could be useful.

7.2 Dutch sustainability policies

Objectives and targets

The ultimate objective of the Sustainability Agenda of the Dutch Ministry of Infrastructure and the Environment (Ministry of IenM, 2011) is that of economic growth that does not exhaust the earth's natural capital. Economic growth must be sustainable in social, economic and ecological aspects. In addition to this, policies for development cooperation aim to structurally combat poverty, and stress that the sustainable use of natural resources also refers to developing countries (Ministry of BuZa, 2012b). To work towards these objectives, policy focal points have been defined in the Sustainability Agenda. Some of them can be related to water footprints:

Raw materials and product chain

1. Efficient use of raw materials
2. Sustainable international supply chains

Sustainable use of water and land

3. Sustainable management of water and land in international cooperation
4. Sustainably dealing with soil and water

Food

5. Sustainable agriculture and livestock
6. Food security and sustainable food systems
7. Transparency in the food chain

Under the Sustainability Agenda's focal point of 'Food', the following targets have been set: decrease the footprint of the Netherlands and minimise the negative impact of food production on biodiversity, climate and water, including a reduction in emissions from supply chains to soil, water and air (Ministry of IenM, 2011; Ministry of BuZa, 2011).

The policy letter on 'Water for development' that describes policy for the 'water' focal point of international cooperation, among other things, states that, by 2015, the increase in food production in partner countries of international cooperation via programmes supported by the Netherlands will be achieved in an ecologically responsible manner, and that water productivity in supported programmes should be improved by at least 25%. It also states that in five drainage basins, tensions over water management should be reduced. The policy letter on 'Elaboration of food security policy' describes policy for the 'food security' focal point of international cooperation. It states that, in the long term, the demand for food and raw materials must be met, taking into account boundary conditions set by water and the environment. (Ministries of BuZa and EL&I, 2011b).

The Taskforce Biodiversity and Natural Resources recommends a 50% reduction in the ecological footprint of the Dutch consumer by 2030, as well as a footprint that will fit the earth's biological capacity by 2050 (TBNH, 2011).

Dutch sustainability policies correspond with international policies of the European Union and the United Nations. The Roadmap to a Resource Efficient Europe (EC, 2011b) sets the objective that 'by 2050 the EU's economy has grown in a way that respects resource constraints and planetary boundaries' and 'all resources are sustainably managed, from raw materials to energy, water, air, land and soil'. The main objective of the Roadmap is to 'decouple economic growth from resource use and its environmental impact'.

The General Assembly of the United Nations has adopted the Rio+20 resolution stating that commitment has been renewed 'to sustainable development and to ensuring the promotion of an economically, socially and environmentally sustainable future for our planet and for present and future generations. Poverty eradication is the greatest global challenge facing the world today and an indispensable requirement for sustainable development' (UN, 2012).

Problem definition

According to the Sustainability Agenda, the Netherlands is eating into its natural capital (e.g. water and biodiversity (Ministry of IenM, 2011). This has an international dimension, as the country to a large degree depends on natural capital from outside its borders. The Ministry of IenM (2011) expects that exhaustion of natural resources will have increasing adverse economic effects.

The Sustainability Monitor for the Netherlands (CBS 2011) states that the Netherlands seizes a relatively large share of global natural resources outside its boundaries; for example, in the form of agricultural land.

According to the policy letter on 'Water for development' (Ministry of BuZa, 2012b), land, water, nutrients and energy are increasingly scarce, pollution of groundwater and surface water is escalating, groundwater supplies are exhausted in important food producing regions and, in the few remaining areas with water abundance in Africa and central Asia, economic developments are often uncontrolled and unequally distributed. There is an exponential increase in water demand. In addition, climate change is leading to unpredictable and irregular precipitation patterns, which in turn increases the stress on water availability. A growing number of countries suffer from water problems caused by climate change, flooding, scarcity and pollution. Natural resources for agriculture and rural development are not being fairly allocated, are managed badly and are becoming more scarce.

Monitoring and evaluation

The Dutch Government aims to maintain an overview of sustainability and greening of the economy (Ministry of IenM, 2011). This overview is provided in the form of the Sustainability Monitor for the Netherlands (CBS, 2011) on the sustainability of Dutch society and the consequences of Dutch actions for sustainable development elsewhere in the world and for future generations.

The resolution by Hachchi and Ferrier (2012) proposes that the Dutch Government, in its economic policy, will advocate that Dutch businesses reveal their water footprint and reduce it in areas with water scarcity.

According to the policy letter on 'Water for development', the dimensions of sustainability in partner countries will be assessed (Ministry of BuZa, 2012).
Furthermore, the EC intends to develop tools for monitoring the progress on resource efficiency in production and consumption. Indicators are needed to cover issues such as the availability, location and efficient use of natural resources, waste generation and recycling rates, and the impacts on the environment and biodiversity. The European Commission is working to ensure that appropriate indicators are available for monitoring and analytical purposes, for example, based on sustainable development indicators (EC, 2011b) (see Section 5.4).

Strategies and implementation
The Netherlands wants to continue to play a role in tackling global problems such as food and water shortages (Ministry of BuZa, 2011). The strategies described below have been formulated in various policy notes (Ministry of IenM, 2011; Ministry of BuZa, 2011, 2012a, 2012b; Ministries of BuZa and EL&I, 2011; Ministry of EL&I, 2011, 2012).

Policy coherence and mainstreaming
Green growth offers opportunities for Dutch businesses. Countries and businesses that create solutions for sustainability problems will profit from that on the world market, according to the Dutch Ministry of IenM (2011). Sustainability policies should be related to the top economic sectors on which the Dutch economic policy is focused (Ministry of BuZa, 2011; Ministry of EL&I, 2011). In the top sectors of agri-food and horticulture, water is an important production factor. Water is obviously the main resource of the top sector of water, but is also related to the top sector of chemistry.

The environment and climate are cross-cutting themes of the focal points of 'food security' and 'water' in international cooperation (Ministry of BuZa, 2011). The emphasis put on the integration of sustainability in economic development will increase the need for high quality knowledge and innovation that may enhance the competitiveness of the Dutch water sector.

Biodiversity conservation and the sustainable use of the related natural resources should guide all relevant policies, including those on agriculture and fisheries, international cooperation, the environment, industry and trade, according to TBNH (2011).

The Europe 2020 Strategy flagship initiative 'A resource-efficient Europe' is intended to ensure that 'we optimise the synergies inherent in such a broadbased strategy, and that we identify and tackle the trade-offs as part of well-informed policy making. It requires a coherent analysis of the reasons why some resources are not used efficiently. From this starting point, it will be possible to make the case for mainstreaming resource efficiency into a wide range of policies, and to develop a set of tools to allow policy makers to drive forward and monitor progress'.

Join forces with businesses, knowledge institutes and NGOs
The Dutch Government aims to stimulate and facilitate cooperation for sustainable development by connecting parties, offering knowledge and information, and financially stimulating innovation (Ministry of IenM, 2011; Ministries of BuZa and EL&I, 2011). Therefore, it intends to cooperate with businesses, knowledge institutes and NGOs and invest in public-private partnerships such as the Sustainable Trade Initiative.

The Dutch Government also advocates the use of the OECD Guidelines for Multinational Enterprises. It intends to support businesses, NGOs and knowledge institutes in their need for more synergy, efficiency and transparency regarding sustainability criteria and assessment methods for the sustainability of production processes and products. This will facilitate the development of sustainability standards and certification.

Transparancy in the food chain: inform consumers
Together with NGOs, the Dutch government aims to address consumers to stimulate sustainable consumption and increase the knowledge base within society. Consumers should be provided with accurate information about the way their food is produced, so that they can make informed decisions (Ministry of IenM, 2011).

Sustainable water management in partner countries in international cooperation
The Netherlands aims at improving water management in drainage basins in cooperation with (local) authorities, knowledge institutes and NGOs that are active in those drainage basins, using an integral approach of sustainable management of water resources and ecosystems and sustainable product chains. The responsibility relationship between authorities and water users receive special attention to increase ownership of water systems and stimulate sustainable use. The aim is to increase production by the sustainable use of land and water. Food production can be increased in agricultural areas that are irrigated, rain fed, or prone to flooding. Increases in food production in partner countries via programmes supported by the Netherlands will happen in an ecologically responsible manner. Sustainable production may be a catalist of economic growth and export as well as combat poverty. (Ministry of BuZa, 2012b; Ministries of BuZa and EL&I, 2011).

Join forces in the international arena
The Dutch Government intends to uses its influence and participates in the steering of relevant multilateral organisations such as FAO, World Bank, IFAD, UNICEF, WHO, Asian and African Development Bank and the EU, to propagate sustainability and pursue 'international water diplomacy' (Ministry of BuZa, 2011). For example, the World Bank could be asked to monitor the strict compliance with guidelines in the field of sustainability and corporate social responsibility in financed projects (Ministry of BuZa, 2012b). In the context of sustainable development and economic diplomacy, there may be closer cooperation with organisations such as the World Business Council for Sustainable Development and World Economic Forum.

7.3 Usefulness of the water footprint indicator

The water footprint indicator hardly reflects environmental impacts, or resource use efficiency or sustainability of water use, and is not suitable to be used for setting goals, defining problems, developing strategies or monitoring in the context of sustainability policies (see conclusions in Chapter 2). Nor is the indicator suitable to inform consumers about the level of sustainability of their consumption, to help them making informed decisions, or to be applied in certification and labeling. Information about resource use without the context of the environmental, social and economic impacts caused by this use, has no value for sustainability policies. In the case of water resources, sustainability boundaries are set at the scale of drainage basins and groundwater aquifers. This is different from, for example, greenhouse gas emissions, where planetary boundaries are set on a global scale. Therefore, in order to make this a useful indicator for policy-making, information on the location of a water footprint is essential.

The grey water footprint is an exception. It is an environmental impact indicator as it is a measure of the severity of overall pollution along the product and supply chain, set against water quality standards. However, water quality aspects are not fully elaborated in water footprint tools and databases, and a lack of data may hamper practical application. For companies that monitor their own pollution and that of their suppliers, the grey water footprint could be a useful indicator for setting emission reduction targets, monitoring and reporting on progress made in emission reduction, and benchmarking. For countries and companies that depend on default databases, rules of thumb or models to calculate their grey water footprint, this footprint would give an impression of the overall pollution along their product and supply chains. But for benchmarking, monitoring and reporting on progress made in emission reduction, a grey water footprint calculated in this way would not be distinctive enough.

7.4 Usefulness of water footprint sustainability assessment

A water footprint sustainability assessment can be a useful approach to set priorities for further investigation and policy-making in the field of sustainability. In such water footprint sustainability assessments, unsustainable hot spots could be traced along production and supply chains. These are locations where a production process uses water from overexploited water resources, pollutes water to the point of exceeding water quality standards, or where water allocation and use are considered unfair or inefficient. Production or consumption of goods and services cannot be considered sustainable if one of the water footprint components along the product and supply chain would be located in an unsustainable hot spot.

Steps in a water footprint sustainability assessment
The Water Footprint Assessment Manual by Hoekstra et al. (2011) describes a theory and provides certain formulae for assessing the sustainability of water footprint components based on water volumes, and for tracing unsustainable hot spots. There are also other approaches to trace unsustainable hot spots; for instance, in corporate water risk assessment and Life Cycle Assessment. As methods and applications are still developing and in an experimental phase, there is a gap between the idea behind and theoretical potential of these tools and their applicability in current practice of Dutch policy-making. Currently, there are more opportunities for application at company level than at national level, as companies usually know the water use and pollution along their production chains and are able to assess that of their supply chains.

A major handicap on a national level is the lack of geographically detailed data providing information about locations and sizes of water footprint components and about the vulnerability of such locations in terms of water scarcity, pollution, fairness or efficiency of water allocation and the effectiveness of water governance. Data gathering and processing on a national scale in the Netherlands are not accurate enough to provide this information. Top-down generated data that are based on trade statistics are insufficiently geographically focused, and currently there is no institution that - bottom-up - gathers and subsequently aggregates data generated by companies into information about hot spots on a national scale. For the time being, an update of top-down generated data to determine potentially risky commodities imported into the Netherlands could be combined with assessments carried out by companies to verify these findings.

The amount of 'virtual' water imported into the Netherlands is related to the goods and services that are consumed by the Dutch public, either directly or after local processing, or to goods that are further processed in the Netherlands and subsequently exported again, or to goods in transit. These different flows of goods each involve certain actors. If the water footprints of Dutch consumption and production are considered, there is an overlap in the production for the Dutch market. The following exploration only refers to products that are consumed or produced within the Netherlands, as it is assumed that there are more options to influence their supply chains than those of goods in transit.

Distinguish between green, blue and grey water and locate footprint components
In order for the water footprint approach to be useful for sustainability policies, first a differentiation should be made between the three components: 'green water', 'blue water' and 'grey water', as they all have different impacts on the environment. Most environmental problems are related to blue and grey water, which are often the smallest components of a water footprint. The water footprint components should be located and placed in their physical and socioeconomic contexts to reveal their contribution to water-related problems. Impacts depend on the vulnerability of the catchment area where the footprint component is located or the groundwater aquifer from which water is abstracted, and on other strains put on local water resources. Vulnerability has a physical and a governmental dimension, the latter referring to the existence of accurate institutions for developing water management policies, and enforcing implementation and compliance with standards.

A blue water footprint component may contribute to overexploitation of water resources at hot spots. Water shortages may occur year-round or specifically in dry seasons or periods. A certain minimum water flow is required to sustain aquatic ecosystems and the human well-being and livelihoods that depend on them.

To assess the environmental impact of the grey water footprint and develop strategies to reduce it, it is necessary to assess water pollution and water quality at the locations of the footprint as well as the effects downstream. According to the method described in the Water Footprint Assessment Manual (Hoekstra et al., 2011), polluting emissions are converted to volumes of water and these volumes subsequently are compared against the assumed run-off in the catchment area. This may be a suitable method in modelling, but in actual practice it has proven to be more convenient to directly assess the emissions along the product and supply chains and their effects on water quality. To reduce the emission of pollutants it is necessary to know the types of pollutants and relevant production processes involved. The most appropriate level for doing so would be the company level.

A green water footprint does not reflect environmental impact unless a certain crop evaporates more water than the natural vegetation would have done. The green water footprint is directly related to land use and relevant for issues concerning fairness and economic efficiency of land and water allocation (Hellegers, 2011). Making the green water footprint more resource-efficient by optimising the use of rainwater (green water) also may reduce the need for irrigation (blue water), or irrigated agriculture elsewhere. Green water is directly influenced by changes in precipitation patterns caused by climate change. Therefore, green water is a relevant component in catchment assessments that include future scenarios.

Assessment of water resources in catchment areas
An important step in a water footprint sustainability assessment is an integrated water resource study of the catchment areas or sub-catchment areas where the major water footprint components are located, comparing total water use to availability and total water pollution to assimilation capacity. Information about unfair or inefficient water use may be gathered from local stakeholders or authorities.

Information about the sustainability of water use and pollution in catchment areas may also be available, as catchment studies are not new and methods and tools for these types of studies have been developed also outside the water footprint community. The strength of adding a water footprint approach to a catchment study would be the involvement of distant consumers, producers and investors – in addition to local stakeholders and authorities – in addressing water problems in hot-spot areas (Bayer et al., 2009; Pfister, 2011). All actors involved share the interest and responsibility to manage water resources well. In this way, strategies of integrated water resource management in catchment or sub-catchment areas can be supplemented with companies' strategies of risk perception and reduction, thus reinforcing each other.

Usefulness for formulating objectives and setting targets
Sustainability policy should focus on eliminating and preventing unsustainable hot spots along product and supply chains. Targets and objectives for sustainably dealing with water in product and supply chains could be formulated on both company, national and European scales, in terms of reducing blue water footprints in areas with water scarcity, and reducing water pollution starting with vulnerable locations. However, it is usually not enough to reduce one blue or grey water footprint for the elimination of those hot spots. Sustainable water use can only be achieved in cooperation with local authorities and other actors in catchment or sub-catchment areas where the hot spots are located. Groundwater aquifers may involve other actors and authorities. Elimination of hot spots needs tailor-made solutions in the context of integrated water resource management. Companies and investors along supply chains with a footprint in these areas may contribute to these solutions in the form of technical or financial support, knowledge or facilitation. Countries may do the same in the context of bilateral cooperation, involving local authorities and actors as well as 'distant' stakeholders along the supply chain to organise more leverage.

The water footprint approach could add an extra dimension to targets that are focused on improving water productivity, increasing food production in an ecologically responsible manner and reducing tensions about water management in drainage basins in programmes supported by Dutch international cooperation. Along the lines of 'water footprint thinking', increased production of export crops and products in an ecological responsible manner could be achieved and measures could be taken to counter water stress with the involvement of actors in the supply chains of these crops and products.

A global objective for sustainable water use could be to produce as many water-demanding goods as possible at locations with abundantly available green and renewable blue water – within limits set by other interests, such as the preservation of ecosystems and biodiversity. This would minimise the environmental impact related to the water footprint of global production. This point is mentioned as one of the reasons for taking green water into account in water footprint assessments (Hoekstra et al., 2011). There are developments in this direction where countries and companies look for arable land in areas that enable rain-fed agriculture, driven by water risk management and water scarcity within their own borders. These developments may have positive spin-offs for countries with water abundance, as they offer economic opportunities, but may also present negative spin-offs for communities if they lead to land and water grabbing. Global optimisation of production based on the availability of natural resources seems only a sustainable solution if it goes hand in hand with vigorously enforced fairness criteria. In addition, the locations of such optimisation of production, from a perspective of sustainable resource use, should be chosen based on other criteria in addition to water availability.

Usefulness for problem definition
The contribution of Dutch consumption and production to worldwide unsustainable water use can be indicated by the volumes of 'virtual' water imported from unsustainable hot-spot areas, where grey water volumes are related to hot spots of water pollution and blue water volumes to hot spots of water stress. In case of unfair water allocation or inefficient water use, green water volumes are also relevant. Not only the volumes of unsustainably used water, but also and especially the locations of the hot spots and commodities involved are useful for a more precise problem determination. As described above, currently, accurate data are lacking to calculate these quantities on a national scale, but an estimation can be made of most risky commodities, along the same lines as was done by Van Oel et al. (2008) for Dutch consumption (Section 3.3).

Usefulness for monitoring and evaluation

Water footprint data on a national scale are currently not distinctive enough to monitor the progress made in sustainably dealing with water related to Dutch consumption and production. However, accurate data may be available or could be made available at company level. The Dutch Government could consider investigating the feasibility of investing in a system of bottom-up monitoring of blue water footprints and pollution in hot spots related to Dutch consumption and production, based on reporting by companies. Priorities could be those commodities with a high risk of being unsustainable, traced by analyses based on trade statistics.

Companies would do better to report in their sustainability reports any progress made in reducing their blue water footprint and the emission of pollutants in unsustainable hot-spot areas, rather than revealing their overall water footprint. Progress made towards a fair and efficient allocation of land and water could be part of certification procedures for good water stewardship. Companies could monitor and report their efforts and projects in hot-spot areas as well as any resulting reduction in water use and pollution. However, monitoring the outcome in terms of the sustainable state of water systems in catchment areas or groundwater aquifers remains the responsibility of local authorities.

A water footprint approach can play a role in the assessment of the dimensions of sustainability in partner countries, in the context of international cooperation. Water scarcity or pollution may be caused or partly caused by the production of export goods, in other words by the unsustainable water footprints of distant consumers and producers. Production of export goods may also be related to problems of fairness and economic efficiency in land and water allocation and fair distribution of profits. This gives an external dimension to the sustainability of resource use in partner countries.

Usefulness for policy strategies and implementation

Mainstreaming and joining forces with businesses, knowledge institutes and NGOs

The prominent position of the Netherlands in the global agricultural market offers opportunities to stimulate companies to trace their activities in hot spot areas, to stimulate their work on reducing water stress and pollution in these hot-spot areas, and to prevent the emergence of new ones. The Dutch Government may build on the increasing public awareness of the global dimension of water problems to urge companies to act accordingly. Government, companies, NGOs and networks, such as sector organisations and round-tables, could collaborate in this process.

This fits well with the growing attention that companies and investors award to sustainable corporate water management and water-related business risks, addressing both direct and supply chain operations. Tools and reporting formats have been developed to support these initiatives in the context of corporate risk assessment, standards for good water stewardship and Life Cycle Assessment (Appendix 5). These initiatives could join forces with the water footprint community, to support further development and the practical application of methods and tools supporting sustainable water use in product and supply chains. The Dutch Government could stimulate and facilitate these processes of cooperation. It could facilitate and stimulate the exchange of data, experience and knowledge and stimulate benchmarking, as lack of data is a problem and water footprint sustainability assessments by companies are in an experimental phase. The Water Footprint Network and sector networks play a central role in this learning process.

Water issues in product and supply chains should be included in sustainability standards for organisations and products. Dutch companies and NGOs, currently, are actively involved in several round-tables (on soy, palm oil, cotton, and biomass for energy) and could expand on the information generated by these initiatives to also include other commodities. The Dutch Government could use its influence to support the adoption of supply-chain-related water issues in such round-table discussions and, for instance, in the performance standards and tools of the World Bank's IFC, Global Water Partnership, WBCSD and Global Reporting Initiative. Initiatives to internationally harmonise organisation and product certification methods that include water in product and supply chains also could be supported.

The Dutch Government requires from internationally operating companies that they comply with the OECD Guidelines for multinational enterprises. These recently have been supplemented with new guidelines that deal with supply chains in addition to production processes by companies themselves, but do not specifically address water issues. Tracing hot spots in production and supply chains and working on solutions with local authorities and stakeholders in the context of integrated water resource management could be considered to be an interpretation of addressing water issues according to the general guideline 'dealing responsibly with natural resources'.

Connecting supply chains to catchment areas
Actors in supply chains can be involved in sustainable water management, reducing water stress and increasing production in a sustainable way in catchment areas where bilateral projects are carried out in the context of international cooperation.

Informing consumers
Consumers could be informed about distant water problems related to products, alternatives that do not have these problems, and activities that are being undertaken to solve these problems.
Harmonisation of standards in the food sector is definitely needed, as there is a myriad of standards and labels, but not one completely satisfying for all targets of sustainable water use. The ENVIFOOD initiative looks promising and could be followed and stimulated. The European Ecolabel for non-food products, based on LCA, endeavours to become a standard at European level but does not include water quantity aspects. Incorporation of water quantity aspects in the Ecolabel could be proposed.

Joining forces in the international arena
In international fora with multilateral and funding organisations and national governments, dialogues may be started on the tension that exists between agricultural export activities and water scarcity and pollution. Countries may be encouraged and supported to carry out economic analyses of water supply and demand options for the future. (Postle et al., 2011). For example, trade missions to rapidly growing economies, such as those of China, India and Turkey, could be used to discuss the risks stemming from unsustainable water use and to promote these economic analyses. China, India and Turkey, currently, are facing increasing problems of water scarcity and pollution.

7.5 Options for Dutch policies to stimulate sustainable water use

Sustainable water use may be addressed in several policy fields and focused on consumer behaviour, resource efficiency in the product and supply chains, reducing impacts in catchment or sub-catchment areas and groundwater aquifers, and reducing the use of hazardous materials in general (EU REACH Regulation (Registration, Evaluation, Authorisation and Restriction of Chemical Substances) and EU pesticide authorisation arrangements). Key question is not just about the usefulness of the water footprint for Dutch policy making, which is a one-way approach, but also about how Dutch policies could support the development and implementation of the water footprint and other approaches that address water use in production and supply chains, such as water risk assessments and Life Cycle Assessments, so that they could become more useful for reaching the goal of global sustainable water use. This is a shared goal.

Specifically, the Dutch Government could take action in the various fields as described below:

In international trade and economic policies, the government could:
- use its prominent position in agricultural trade to promote and stimulate sustainable water use in product and supply chains;
- stimulate Dutch enterprises that do business abroad to meet sustainability standards that include sustainable water management in their product and supply chains and report their performance, and impose this on businesses that receive some form of financial support;
- stimulate the application of European standards and regulations on the use of hazardous materials and the emission of pollutants by companies connected to Dutch consumption and production in countries that do not have strict regulation themselves;
- stimulate innovations that serve good water management in relevant top sectors;
- use international trade missions to rapidly growing economies to discuss the economic risks stemming from unsustainable water use and to promote economic analyses of water supply and demand options for the future.

In international cooperation, the government could:

- start dialogues with international funding organisations, governments of partner countries and other relevant parties, on the tensions that exist between export activities and water scarcity and pollution;
- encourage partner countries in international cooperation that face water scarcity or pollution problems to carry out economic risk assessments regarding their water use and allocation, involving companies with a footprint in the related hot-spot areas;
- apply a 'water risks and sustainability' check within the framework of international cooperation for supported economic projects in partner countries;
- promote a joining of forces between sustainable supply chain management and integrated water resource management in hot-spot catchment areas.

In relation to standards and certification, the government could:

- stimulate initiatives to internationally harmonise standards for good water stewardship and corporate water disclosure;
- support initiatives to internationally harmonise the way water issues are addressed in product labelling;
- Elaborate on the OECD Guideline for multinational enterprises 'dealing responsibly with natural resources' for water.

In relation to consumers, the government could:

- support campaigns to educate consumers and raise awareness of the environmental impacts of consumption, including those on global water resources.

In relation to research and development, the government could:

- stimulate cooperation between different networks to join forces for the development of tools and databases that would be useful for making product and supply chains more sustainable, also in relation to water use;
- support the development of the water footprint theory, for instance, by stimulating and facilitating an open forum discussion about the theory, including methods and criticisms;
- support the development of methods that couple production and supply chain assessments to socioeconomic assessments of water allocation in catchment areas.

In relation to monitoring and data processing, the government could:

- Investigate the feasibility of organising bottom-up data gathering and data processing related to water pollution along product and supply chains, blue water footprints in hot-spot areas and progress made towards tackling water problems in hot-spot areas, to be aggregated into information on a national scale;
- stimulate Statistics Netherlands and other relevant institutes to collect the data needed to perform reliable water footprint sustainability assessments on a national scale;
- work towards agreement on monitoring methodologies and commitment on the data flow process on a European level, under the flag of the EU Resource Efficiency Roadmap.

7.6 Conclusions

The local context of a water footprint is essential for making it into a useful tool for sustainability policies

Boundaries for sustainable use of water resources are set at the scale of catchment areas and groundwater aquifers. Approaches that aim for the sustainable use of water resources should consider the vulnerability of catchments and groundwater aquifers. As the water footprint indicator does not do this, it is not suitable to be used for setting targets and developing strategies for sustainability policies, nor for benchmarking, certifying or monitoring the progress made by companies, consumers or countries towards sustainable water use. Moreover, the indicator does not offer appropriate information for consumers to make sustainable choices.

Only the grey water footprint component can be considered an indicator of environmental impact, as it reflects severity of overall pollution along product and supply chains, set against water quality standards. Its usefulness in practice depends on data availability. Companies that monitor their own emission of pollutants to water and that of their direct and indirect suppliers may use the indicator for setting emission reduction targets, as well as for benchmarking, monitoring and progress reporting. On a national scale, this indicator is currently not distinctive enough to be used for benchmarking and monitoring. For formulating strategies and measures, the grey water footprint does not offer enough information for companies or countries, as this would require information on types of pollutants, locations of the pollutions as well as production processes.

A water footprint sustainability assessment considers sustainability of water use and pollution in catchment areas and groundwater aquifers and, therefore, is useful for sustainability policies. In such water footprint sustainability assessments unsustainable hot-spot areas could be traced along the product and supply chain, where production processes use water from overexploited water resources, pollute water to the point of exceeding water quality standards, or where water allocation and use are considered unfair or inefficient. Production and consumption of goods and services cannot be considered sustainable if one of the water footprint components along the product and supply chains would be located in an unsustainable hot-spot area.

However, although the theory and ideas behind the water footprint sustainability assessment are useful and essential to make consumption and production sustainable in terms of water use, the method is still being developed and in an experimental phase. This is hampering its practical application. On a national scale, data are not accurate enough to locate water footprints in sufficient detail to trace hot-spot areas. Top-down generated data based on trade statistics are insufficiently geographically focused, and currently there is no institution that - bottom-up - gathers and subsequently aggregates data generated by companies to information about hot-spot areas on a national scale. For the time being, an update of top-down generated data to determine potentially risky commodities could be combined with assessments carried out by companies to verify these findings. There is a central role for companies as these are in a position to trace and track possible hot-spot areas along their production and supply chains and in product use. They too can use a multi-stage approach, first tracing potentially risky production processes and locations, followed by a more profound investigation. In order to do this, they could use methods offered by corporate risk assessments, Life Cycle Assessments or water footprint sustainability assessments.

National or corporate sustainability policies with regard to water could be focused at resolving and preventing unsustainable hot-spot areas. Strategies could be aimed to reduce water pollution and blue water use in these hot-spot areas. Countries and companies could also support sustainable use of water resources in catchment areas, sub-catchment areas or groundwater aquifers where they have a water footprint. Green and blue water use and water pollution are relevant for a fair allocation and sustainable and efficient use of land and water. Integrated water resource management in catchment areas should involve local actors as well as ‘distant’ actors in the supply chains with a footprint in those areas.

This approach fits with the growing attention paid to supply chains by companies from a general sustainability or business-risk perspective, and may contribute to the mitigation of global water problems. It may generate additional resolving power as – in addition to local stakeholders and authorities – it also involves distant consumers, producers and investors along the supply chain when addressing water problems in unsustainable hot-spot areas. In this way, strategies of integrated water resource management (IWRM) in catchment areas and those of risk reduction by companies may reinforce each other.

There are several options for Dutch policies to support sustainable water use along product and supply chains, within the context of economic and trade policies, international cooperation, standards and certification, consumer education, research and development, and monitoring.

Appendix 1:
Translation of the Motion by Hachchi and Ferrier

MOTION by Members of the Dutch House of Representatives Hachchi and Ferrier
Submitted 5 April 2012

The House of Representatives,

after hearing the deliberations,

has found that many people, currently, still do not have access to clean drinking water and sanitary facilities, and that increasing water scarcity is a threat to sustainable growth in many developing countries;

has found that the Netherlands, by importing water-intensive goods such as clothing made of cotton, is a 'virtual' importer of 71 billion cubic metres of fresh water, and therefore takes a position in the global top ten;

is of the opinion that, within the context of the broader coherence of policy on developing countries, efforts to reduce the Dutch water footprint abroad should be a government priority, especially in areas affected by water scarcity,

requests that the government, in its economic policy, aims for Dutch companies to present their water footprint and to reduce this footprint in those areas that are affected by water scarcity, for example, by actively addressing companies that receive support through export guarantees or innovation subsidies to reduce their water footprints, and to request that these companies calculate their water footprints and include this information in their sustainability reports;

also requests that the government, on an EU level, during the reform of the Common Agricultural Policy, will aim to reduce the subsidising of water-intensive agriculture in areas of water scarcity, such as the cotton production in Mediterranean countries,
and proceeds to the order of the day.

Hachchi

Ferrier

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Appendix 2:
Translation of the letter by the State Secretary of Foreign Affairs to the Dutch House of Representatives concerning the Hachchi–Ferrier resolution

To the Chair of the House of Representatives
Binnenhof 4
The Hague

Date: 6 June 2012
Subject: The suspended resolution by Hachchi and Ferrier on the water footprint (32605 no. 81)

Dear Chair,

Enclosed, also on half of the State Secretary of Infrastructure and the Environment, please find my response to the suspended resolution by Hachchi and Ferrier on the Dutch water footprint abroad (32605 no. 81). As agreed, I conferred with my colleague at the Ministry of Economic Affairs, Agriculture and Innovation as well as with Statistics Netherlands.

Within the context of the broader coherence of policy on developing countries, the Dutch Cabinet supports the government efforts to reduce the Dutch water footprint abroad, especially in areas affected by water scarcity. Further research will be required in order to determine whether the water footprint approach would be an appropriate policy tool for coherence with regard to water scarcity.

The first part of the resolution concerns the aim to have Dutch companies report on their water footprint abroad. A number of companies is already paying attention to water issues in their sustainability report. Companies that receive subsidies, to a certain extent, are asked about the impact of their activities related to water use. For example, insurance company Exportkredietverzekeringen (EKV) already pay attention to water scarcity in their environmental and social effects report, as this applies to EKV's risk-bearing projects.

In the second part of the resolution, the government is requested to persue, on an EU level, during the reform of the Common Agricultural Policy, the reduction in the subsidising of water-intensive agriculture in areas of water scarcity.

The Dutch Govenment, in EU context, strives for a full reduction in the support that is directly linked to production. Cabinet efforts concerning the European Commission's proposals for reform of the Common Agricultural Policy (CAP) for the 2014–2020 period already have been reported to the Dutch House of Representatives (TK 28 625, no. 117). The Dutch Cabinet also supports EC proposals for using the CAP to achieve the European objectives for 2020. Important themes, in this respect, are sustainable agricultural production and innovation, also involving issues such as the efficient use of water.

Cabinet in its efforts regarding the current CAP, generally, strives for greater coherence between policies on developing countries, with an emphasis on the monitoring of external effects on developing countries (also see the Cabinet reaction).

In summary, the first part of the resolution may be seen as supporting policy. Further research, however, is required into the suitability of the water footprint as a policy tool for Dutch policy. Therefore, I have requested the PBL Netherlands Environmental Assessment Agency to conduct a study into this subject. Together with Statistics Netherlands (CBS) and CPB Netherlands Bureau for Economic Policy Analysis, PBL monitors the Cabinet's Sustainability Agenda for a green growth strategy for the Netherlands (*Groene Groeistrategie voor Nederland*, TK 33 041 no. 1). Within this context, PBL is already working on a report about reducing the ecological footprint and making it more sustainable. The requested study on the water footprint can build on its results. Furthermore, I hereby emphasise the importance of sustainable agriculture in European areas with water scarcity. The Dutch Cabinet does not consider a one-sided reduction in EU subsidies as the most suitable instrument to achieve this. The Netherlands, therefore, supports the European Commission in using the Common Agricultural Policy for achieving the European objectives for 2020. I, thus, strongly advise against the second part of this resolution in its current form.

The State Secretary of Foreign Affairs,
Ben Knapen

Appendix 3: Company-level water footprint studies

The table below presents an overview of company-level water footprint studies and pilot studies, compiled from Postle et al. (2011) and WFN (2012) and supplemented by own research.

Company	*Main activities*	*WFN[1)]*	*Mandate[2)]*	*Water footprint reports*
Anglo American	mining	-	-	-
BIER[3)]	beverages			BIER (2011)
Borealis	chemicals	-	-	Borealis (2009), Katsoufis (2009)
C&A	clothing	++	-	-
Concha & Toro	wines	+	-	-
CosuizAgua[4)]	various			Borgensten et al. (2010)
Dole Food Company	food	+	-	Sikirica (2011)
Heineken[5)]	beer	+	+	-
Jain Irrigation Systems	irrigation, food	+	-	Larson et al. (2010)
Kimberly-Clark	paper-based products	-	-	-
Lafarge	building materials	+	-	-
Mars Australia	food	-	-	Ridoutt and Pfister (2010)
Multi-One Design	sailing boats	-	-	-
Natura	personal care	+	-	-
Nestlé	food, beverages	+	+	Chapagain and Orr (2010)
PepsiCo	food, beverages	+	+	-
Raisio	food	+	-	-
Royal Dutch Shell	oil	-	+	-
SABMiller	beer	+	+	SABMiller (2009, 2010, 2011)
Stora Enso	forestry products	+	+	-
Suez Environment	water management	-	+	-
The Coca-Cola Company	beverages	+	+	TCCC (2010, 2011)
The Danone Group	food, beverages	-	+	-
Unilever	food, beverages, cleaning, personal care	+	+	-
UPM Kymmene	forestry products	+	+	Rep (2011)
Veolia Environment	water and waste management	-	-	-

1) Water Footprint Network: ++ = Sponsoring Partner; + = Regular partner; - = No partner.
2) UN CEO Water Mandate: + = Endorsing company; - = No endorsing company.
3) Beverage Industry Environmental Roundtable.
4) A partnership with Alpina, Clariant, Holcim, Nestlé and Syngenta.
5) See Heineken (2010, 2011, 2012).

Appendix 4: Round tables on sustainable supply chains

A number of round tables and comparable business initiatives are addressing sustainable production and supply chains for various products. All these initiatives, to a greater or lesser extent, are involved in water-footprint-related issues that are incorporated in standards and certification schemes. Explicit references to water footprints are only made in three cases, namely Textile Exchange, the Beverage Industry Environmental Roundtable (BIER) and the European Food Sustainable Consumption and Production (SCP) Round Table.

Round tables or comparable business initiatives on sustainable supply chains have been established for the following products or product groups:

- *Tea*
  Started in 1997 as a group of UK-based tea packing companies, such as the Tea Sourcing Partnership, the Ethical Tea Partnership (ETP) was founded in 2004,. The ETP has increased active communication with stakeholders and plays a more proactive role in the ethical trade in tea (ETP, 2012). Members of ETP are 23 tea companies, working with tea producers and companies at each end of the tea supply chain, to create a thriving tea industry that operates with social fairness and that is environmentally sustainable. Since 2009, ETP has been involved in the tea programme of the Dutch Sustainable Trade Initiative (IDH, 2012a). The ETP Standard applies to all locations where tea leaves bought by ETP members are produced or processed.

- *Cotton*
  First started in 2001 as the Organic Exchange, its successor, the Textile Exchange, was founded is 2002 as a non-profit, membership-based organisation (TE, 2012). Currently, the Textile Exchange has around 180 members, mostly consisting of companies, and includes Levi Strauss, Nike, C&A and H&M. In addition, the Better Cotton Initiative (see below) and CottonConnect are also member of the Textile Exchange. Its mission is to inspire and equip people to accelerate sustainable practices in the textile value chain, focusing on minimising the harmful impacts of the global textile industry and maximising its positive effects. Water footprinting is an issue on the website of Textile Exchange in the context of the environmental impacts of cotton production on water, also providing a link to the UNSECO-IHE report ‘The water footprint of cotton consumption’ (Chapagain et al., 2005).
  The Better Cotton Initiative (BCI) was established in 2005 (BCI, 2012). BCI's philosophy is to develop a market for a new mainstream commodity: ‘Better Cotton’, and thereby to transform the cotton commodity to bring long-term benefits for the environment, farmers and other people dependent on cotton for their livelihoods (BCI, 2009). Members are societal organisations (including Solidaridad and WWF), producers, retailers, suppliers, manufacturers and associate members (including the Textile Exchange and CottonConnect). During the course of 2009, a group of private and public players developed a strategy to speed up the implementation of the Better Cotton System (BCI, 2012; IDH, 2012b). This gave birth to the Better Cotton Fast Track Programme, funded by three Dutch organisations (ICCO, IDH and Rabobank Foundation) and implemented by Solidaridad, WWF, CottonConnect and others.

- *Coffee*
  The Common Code for the Coffee Community (4C) project kicked off in 2003 (4C, 2012). The 4C Association is a platform that brings together all relevant stakeholders in the coffee sector to address sustainability issues in a pre-competitive manner. To date, over 170 members have joined the platform, including coffee farmers, traders, industrial players, societal organisations (including Solidaridad) and private citizens.

- *Palm oil*
  Already in 2001, WWF began to explore the possibilities for a Roundtable on Sustainable Palm Oil (RSPO), which was eventually formally established in 2004 with a governance structure that ensures fair representation of *all* stakeholders throughout the entire supply chain, thus, also including banks, investors and private citizens (RSPO, 2012). The RSPO aims at a palm oil production that is sustainable – both environmentally and socially – and counts several hundreds of member organizations, among which 66 from the Netherlands, including Unilever, Ahold, CSM, Campina, Remia, AkzoNobel, Rabobank, Solidaridad and Alterra.

- *Sugar cane*
  Bonsucro is a non-profit multi-stakeholder organisation that strives to improve the social, environmental and economic sustainability of sugar cane by promoting the use of a global

metric standard, with the aim of continually improving sugar-cane production and downstream processing in order to contribute to a more sustainable future (Bonsucro, 2012). The organisation started in 2005 under the name Better Sugarcane Initiative (BSI), changing its name in 2010 to Bonsucro. The organisation has 59 members, including the Coca-Cola Company, PepsiCo, Unilever, CSM, Shell, Suiker Unie, IFC, Rabobank and WWF.

- *Soy*
  Started in 2004 as the Responsible Soy Forum, the forum was formalised and registered as the Round Table on Responsible Soy Association (RTRS) in November 2006 (RTRS, 2012; SSM, 2012). RTRS is a multi-stakeholder organisation, working at developing standards for responsible soy production, described as ‘soy production that is economically viable, socially equitable and environmentally sound’, with members from the production sector, industry, trade, finance, civil society, and working with observers representing for example NGOs and governments. To date, RTRS counts 150 members, including Ahold, AkzoNobel, FrieslandCampina, Nestlé, Shell, Unilever, IFC, Rabobank, Natuur&Milieu, Solidaridad, TNC, WWF, IDH and WUR.

- *Beverages*
  The Beverage Industry Environmental Roundtable (BIER), formed in 2006, is a partnership of 16 global beverage companies, focusing on water stewardship, energy & climate change and stakeholder engagement (BIER, 2012a). Members of BIER include PepsiCo, the Coca-Cola Company, ABInbev and Heineken.
  In 2010, the Beverage Industry Environmental Roundtable (BIER), formed a working group to evaluate and address the increasing global efforts to develop water footprinting methodologies (BIER, 2011). The working group’s resulting report provides guidance for beverage companies in the application of existing water footprinting tools and the development of new ones. In 2011, BIER completed its fifth annual water benchmarking study. The study evaluated the performance of more than 1,600 beverage manufacturing locations, representing 16 beverage companies (BIER, 2012b) and includes an evaluation of facility performance in water-scarce regions. In addition, the report presents the steps taken by BIER members to expand water stewardship beyond their company walls by accounting for water use in the supply chain.

- *Cocoa*
  The Roundtable for a Sustainable Cocoa Economy (RSCE) is an initiative promoting sustainable production and use of cocoa through dialogue and cooperation with all stakeholders along the production and supply chain, i.e. cocoa farmers and cooperatives, traders, exporters, processors, chocolate manufacturers, wholesalers, governmental and non-governmental organisations, financial institutions, as well as donor agencies (RSCE, 2012). The RSCE is facilitated by the International Cocoa Organization (ICCO), a global organisation composed of both cocoa producing and cocoa consuming member countries (ICCO, 2012).
  The first meeting of the RSCE was held in 2007 in Ghana, the second in 2009 in Trinidad and Tobago. In both cases, the former Dutch Ministry of Agriculture, Nature and Food Quality was one of the sponsors.

- *Biofuels*
  The Roundtable on Sustainable Biofuels (RSB) is an international initiative coordinated by the Energy Center at EPFL in Lausanne that brings together farmers, companies, non-governmental organisations, experts, governments, and inter-governmental agencies concerned with ensuring the sustainability of biofuel production and processing (RSB, 2012). In May 2007, the first meeting of its founding Steering Board was held. Currently, more than 120 organisations from nearly 40 countries representing all sectors are registered RSB members, including DSM, Airbus, Boeing, Shell, WWF and the Dutch Ministry of Infrastructure and the Environment.

- *Food and beverages*
  The European Food Sustainable Consumption and Production (SCP) Round Table is an initiative that is co-chaired by the European Commission and food supply chain partners, and is supported by the UN Environment Programme (UNEP) and the European Environment Agency (EEA) (FOODSCP, 2012a). There are 24 member organisations representing the European food supply chain. Participation in the European Food SCP Round Table is also open to consumer organisations and environmental and nature conservation NGOs. The Dutch Ministry of Economic Affairs and the Dutch Ministry of Infrastructure and the Environment are two of the ‘observer organisations’.

The aim of the European Food SCP Round Table is to establish the food chain as a major contributor to a sustainable consumption and production in Europe. The European Food SCP Round Table's activities will not only help to strengthen the long-term competitiveness of Europe's food chain, but also will support EU policy objectives, notably those outlined in the European Commission's Action Plan on Sustainable Consumption and Production (SCP) and the Sustainable Industrial Policy.
Currently, the Working Group 1 of the round table is identifying scientifically reliable and uniform environmental assessment methodologies for food and drink products, considering their significant impacts across the entire product life cycle. This should result in the ENVIFOOD Protocol (the Protocol for the ENVIronmental assessment of FOOd and Drink (FOODSCP, 2012b). The protocol will follow the principles of Life Cycle Assessment (LCA) and will include a water footprint as one of the indicators. The Working Group 1 has recommended that this water footprint indicator should reflect impact and not be of the inventory (volumetric) type.

Appendix 5: Assessment tools

To reduce the impacts of water footprints through sustainable water management, the first step would be to assess current water management practices, associated impacts and risks, and response options. To that end, a number of tools have been developed from different perspectives, sustainable corporate water management, sustainable water management in production and supply chains, and sustainable management of drainage basins.
Below, the most relevant tools are identified:

- *Water Footprint Network*
  The website of the Water Footprint Network (see Chapter 4) presents several tools and many publications; for instance, The Water Footprint Assessment Manual, calculators for individual water footprints, national water footprint case studies and a database (WFN, 2012). The methodology described in the manual can be applied to various types of water footprint assessments, including those on product and company level (see Chapter 2). The WaterStat database contains data from various studies on water footprints, virtual water, water scarcity and pollution. The Water Footprint Assessment Tool is planned to be a free online web application assisting users in water footprint quantification, sustainability assessment and response formulation. The beta release went online on 11 December 2012. Version 1.0, although originally planned to be released in December 2012, was not yet available online on 11 December 2012 (WFN, 2012).

- *EUREAKA*
  Under its 7th Framework Programme for Research and Technological Development, the EU has funded the One Planet Economy Network project (OPEN:EU). This work resulted in the free to use Internet tool EUREAKA, providing integrated ecological, carbon and water footprint data (OPEN, 2012; EUREAPA, 2012). The tool models the flow of goods and services between 45 countries and regions, covering the global economy for 57 individual sectors in the year 2004. The sectors cover a range from agricultural and manufacturing industries to transport, recreational, health and financial services.

- *Global Water Tool*
  The Global Water Tool (GWT), launched in 2007, is a free to use tool from the World Business Council for Sustainable Development (WBCSD) for companies operating in multiple countries to map their water use and assess risks for their global operations and production and supply chains (WBCSD, 2012). It does not provide specific guidance on local situations that require more in-depth systematic analysis (see *Local Water Tool*).
  The tool was developed under the leadership of WBCSD member and global engineering company CH2M HILL. An advisory board of 21 other global companies, among others Shell and Unilever, provided oversight and pilot testing. Expertise was provided by The Nature Conservancy and the Global Reporting Initiative. More than 300 corporations have used the tool which is regularly updated with improved data sets and functionalities.

- *Local Water Tool*
  The Local Water Tool (LWT), launched in March 2012, is a free to use tool from the Global Environmental Management Initiative (GEMI) that will help companies conduct systematic assessments of their relationship to water in order to create site-specific sustainable water management strategies (GEMI, 2012a, 2012b). Supply chain aspects are not considered.
  GEMI is a non-profit organisation of 26 companies dedicated to fostering environmental, health and safety and environmental sustainability through the sharing of tools and information. The development of the tool was supported by an additional number of participants, among others AkzoNobel and Shell, and carried out in cooperation with the WBCSD to link the tool to the Global Water Tool.

- *Aqua Gauge*
  The Ceres Aqua Gauge is a free to use tool and associated methodology that allow investors to scorecard a company's management of water risk against detailed definitions of leading practice (Ceres, 2012a, 2012b). Direct operations, supply chains as well as the impacts of product use on water are considered.
  Ceres is a US-based coalition of investors, environmental groups, and other public interest organisations working with companies to address sustainability challenges, such as climate change and water scarcity. The tool was developed by Ceres in collaboration with the World Business Council for Sustainable Development (WBCSD), Irbaris, and the IRRC Institute. Input was provided by representatives from over 50 financial institutions, companies and

NGOs, among others PGGM Investments, Robeco Asset Management, WWF and The Nature Conservancy.

- *Water Risk Filter*
  The Water Risk Filter is an online application hosted by WWF (see Chapter 4) which is designed to help companies and investors to ask the right questions about water – to assess risks and give guidance on how to respond to such risks (WWF, 2012a). The application aims to cover all relevant aspects of water risks: physical risks (water scarcity, water pollution, ecosystem threats, dependency on hydropower) including those in the production and supply chain, regulatory risks and reputational risks. These risks comprise those that are basin-related and company-related. Risk levels are determined according the scores on a set of indicators multiplied by a corresponding weighting. The scores come from a facility-specific questionnaire or are derived from a number of global data sources, including blue water scarcity and water footprint data from the Water Footprint Network.
  The application has been developed for WWF in collaboration with DEG KWF Bankengruppe.

- *Corporate Water Gauge*
  The Corporate Water Gauge is a tool of the Center for Sustainable Organizations (CSO) providing an indicator for measuring the ecological sustainability of an organisation's water use, using a watershed-centric approach (CSO, 2012). Supply chain aspects are not considered.
  The tool is not available for free. Licences are granted to clients who engage CSO to either provide related training, or assist with at least one application at a site of their choosing.

- *Aqueduct*
  The World Resources Institute (WRI) is developing the Aqueduct Water Risk Atlas from which a first version is now available for free on the Internet (WRI, 2011, 2012). At the heart of Aqueduct is a global database of water risk information that will enable companies, investors, governments and others to create detailed water risk maps.
  An Aqueduct Alliance, including the Netherlands Ministry of Foreign Affairs, supports the project financially and expert advisors from companies, government agencies, NGOs and academia participate in Aqueduct Alliance Working Groups.

- *GWP toolbox*
  The toolbox developed by the Global Water Partnership (see Chapter 4) is a free and open database to support integrated water resource management with a library of background papers, policy briefs, technical briefs and perspective papers as well as huge sections of case studies and references in each tool (GWP, 2012b). The toolbox pays only limited attention to supply chain aspects and the water footprint concept.

- *Charting Our Water Future*
  Charting Our Water Future is a report by the 2030 Water Resources Group on the possibilities to close the growing gap between (blue) water supply and demand (2030WRG, 2009). The report provides an analytical framework to facilitate decision-making and investment in measures increasing supply and improving water productivity. As a key tool, the 'water-marginal cost curve' is presented, which provides a microeconomic analysis of the cost and potential of a range of existing technical measures to close the projected gap between demand and supply within a particular basin area. The report offers case studies from four countries with drastically different water issues together with an extensive list of assessed measures.

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